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The American STATISTICIAN

The news publication of the
AMERICAN STATISTICAL ASSOCIATION

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APRIL–MAY, 1954
Volume 8, No. 2

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AMERICAN STATISTICAL ASSOCIATION

1954 MEETINGS IN SEPTEMBER

Mount Royal Hotel

Montreal, CANADA

Sept. 10-13, 1954

MONTREAL, Canada's largest metropolis and the world's greatest inland port, is a cosmopolitan city that blends old and new: skyscrapers tower beside historic old buildings that date to the French regime; horse-drawn caleches share the streets with modern automobiles. Although predominantly French-speaking, it is a bilingual city. It abounds in fine eating places that feature dishes of every land as well as the traditional food of French Canada. Situated on the St. Lawrence River, it radiates first-class highways that make travel easy to —

QUEBEC, colorful capital of French Canada and the only walled city in North America, 180 miles northeast by rail or road. Steeped in old-world flavor, this ancient city of hills and narrow streets offers many attractions to the visitor; the world-renowned Chateau Frontenac; the Citadel fortress, summer residence of Canada's Governor General; the historic Plains of Abraham where in 1759 Wolfe defeated the gallant Montcalm to win New France for England. Among the many nearby sights are Montmorency Falls (higher than Niagara) and the Quebec Bridge, longest cantilever span in the world.

THE LAURENTIANS, famed winter and summer resort land, offer much to the bather, fisherman, hunter, golfer and to all sportsmen. On Highway 11, Ste. Adele is but 47 miles away, Val Morin 52, Ste. Agathe-des-Monts 58, St. Jovite 75.

OTTAWA, Canada's attractive capital, is only 123 miles away on Highway 17.

TORONTO, the country's largest English-speaking city, is 354 miles distant.

The American STATISTICIAN

APRIL-MAY, 1954, VOL. VIII, NO. 2

The news publication of the
American Statistical Association

Founded 1839

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The Editorial Committee welcomes the submission of manuscripts for possible publication. Two copies, double-spaced, should be sent to the Editor, Almarin Phillips, E-140 Dietrich Hall, University of Pennsylvania, Philadelphia 4.

News and notes should be sent to Dana Barbour, News Editor, American Statistical Association, 1108 16th Street, N.W., Washington 6, D. C.

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Anyone wishing to change their mailing address should allow eight weeks' notice. A copy of the address taken from an issue of the periodical should accompany the change-of-address request.

REPORT OF THE

COMMITTEE ON ELECTIONS

The Committee on Elections, consisting of Ralph J. Watkins, Chairman, Donald C. Riley and Samuel S. Wilks, has nominated the following persons as candidates for office in 1955:

President-Elect

GERTRUDE M. COX
Institute of Statistics,
University of North Carolina

Vice-President (1955–57)

(One to be elected)

JOHN W. TUKEY
Princeton University

MARTIN GAINSBRUGH
National Industrial Conference Board

Directors (1955–57)

(Two to be elected)

RAYMOND T. BOWMAN
University of Pennsylvania

ALFRED N. WATSON
Wesleyan University Press

ROBERT J. EGGERT
Ford Motor Company

CHURCHILL EISENHART
National Bureau of Standards

Representative-at-Large (1955–56)

(One to be elected)

HARRY ALPERT
National Science Foundation

S. LEE CRUMP
University of Rochester

In accordance with the Constitution, additional nominations may be made within five weeks after this publication by petition signed by at least twenty-five members and submitted to the Secretary-Treasurer. Ballots will be mailed in November at the time of the general mailing for 1955. These ballots will contain biographical material on each of the candidates.

NEWS

Chicago and Albany Chapter Regional Conferences—Annual Meetings of ASQC and Virginia Academy of Science—Biometrics Section Elects —Summer Sessions in Statistics—Conferences—Publications

Midwest Conference on Forecasting Techniques

The Chicago Chapter of the ASA and the Chicago Association of Commerce and Industry are sponsoring a conference on "Forecasting Techniques Applied to Business Problems." The latest techniques of forecasting in the fields of sales, inventory needs, capital requirements, population, and agriculture, will be discussed by specialists whose major responsibility is preparing these forecasts as an aid in effective business management.

Following is the list of speakers who will evaluate the quantitative and qualitative factors of forecasting:

Thomas E. Caywood, Armour Research Foundation, and Caywood-Schiller Associates
Philip Hauser, University of Chicago, and Chicago Community Inventory
Seymour E. Heymann, Signode Steel Strapping Company
George Hitchings, Ford Motors
Nathan M. Koffsky, U. S. Department of Agriculture
Richard O. Lang, S. C. Johnson Company
W. D. McEachron, Standard Oil
William A. Neiswanger, University of Illinois
Arthur Rosenbaum, Sears Roebuck and Company
Alfred N. Watson, Wesleyan University Press Inc.

The Conference will be held Saturday, April 24th, at the Central Y Building in Chicago. It will include five sessions composed of eight speakers and two discussants. The Conference will last from 9:00 A.M. to 4:30 P.M. and includes a luncheon. The registration fee of $7.50 should be sent to:

Mr. De Ver Sholes
Association of Commerce and Industry
One North La Salle Street
Chicago 2, Illinois

N. Y. State Conference on Government Statistics

The Albany Chapter of the American Statistical Association is sponsoring a one day conference of government statisticians in Albany on June 4, 1954. The theme of the conference will be "The Role of the Statistician in State Government". The conference is a new project designed to make possible more effective use of the State's statistical facilities through an interchange of ideas on a broad basis.

The conference will be opened by an address by Mr. Frank C. Moore, formerly Lieutenant Governor of the State of New York, and now President of the Government Affairs Foundation, Inc. Other speakers will include Commissioner Ewan Clague of the U. S. Bureau of Labor Statistics and Dr. W. Edwards Deming of New York University. Mr. T. N. Hurd, Director of the Budget for New York State will moderate an afternoon panel discussion at which administrators and statisticians from several state departments will discuss the production and utilization of statistics of state agencies. Member of the panel are Donald H. Davenport, Deputy Commissioner and Director, Division of Economic Development, Department of Commerce; Meredith B. Givens, Director of Research and Statistics, Division of Employment; Dr. Herman E. Hilleboe, Commissioner, Department of Health; Milton O. Loysen, Executive Director, Division of Employment; David M. Schneider, Director of Research and Statistics, Department of Social Welfare.

All who are interested in government statistics are cordially invited to attend. Further information and luncheon reservations may be obtained by writing to Abbott Weinstein, New York State Department of Commerce, 112 State St., Albany, N. Y.

Annual Convention of the American Society for Quality Control

The American Society for Quality Control will hold its eighth Annual Convention in St. Louis from June 8–11, 1954. There will be 67 Technical and Advanced sessions, as well as social activities and an unusually large exhibitor display. Of particular interest to statisticians is the scheduled session on "Experimental Designs" at which D. S. Villars, Research Scientist at the U. S. Naval Ordnance Test Station, China Lake, California; and Cuthbert Daniel, Consultant Engineering Statistician, will present papers.

Annual Meeting of Virginia Academy of Science

The Virginia Academy of Science, which includes an active Statistics Section under the chairmanship of Dr. R. A. Bradley, will hold its annual meetings at the University of Virginia, Charlottesville, Virginia the 6th, 7th and 8th of May, 1954. The Academy has a large membership including statisticians from Virginia, Washington, D. C. and neighboring states. Approximately twenty papers will be presented in the statistical sessions.

Election of Officers for the Biometrics Section

At the recent annual meeting of the American Statistical Association, the Biometrics Section elected the following officers who will serve under the chairmanship of S. Lee Crump, University of Rochester.

President-Elect, PAUL G. HOMEYER, Iowa State College,

Secretary, PAUL N. SOMERVILLE, Virginia Polytechnic Institute,

Section Committee, MARY ELVEBACK, University of California, PAUL MEIER, Johns Hopkins University, BERNICE BROWN, Rand Corporation, IRWIN J. D. BROSS, Cornell University Medical School.

Summer Sessions at Berkeley, California

This year's program at the Statistical Laboratory of the University of California, Berkeley, California, consists of two sessions: June 21–July 31 and August 2–September 11, 1954. The faculty of the summer sessions will include Professor C. R. Rao of Presidency College, Calcutta; Professor J. Neyman, Professor Harry M. Hughes and Professor Terry A. Jeeves of the Statistical Laboratory, University of California.

The program includes two of the usual undergraduate courses in each session. In addition Professor Rao will give a new course designed to acquaint students with multivariate analysis, including analysis of variance and covariance, factor analysis, and discriminant functions. Professor Neyman will be available for consultations on work leading to higher degrees. Further information may be obtained by writing the Statistical Laboratory, 5416 Dwinelle Hall, University of California, Berkeley 4, California.

Southern Regional Cooperative Graduate Summer Sessions in Statistics

As previously announced, beginning in 1954, North Carolina State College, the University of Florida, Virginia Polytechnic Institute and the Southern Regional Education Board will jointly sponsor cooperative graduate summer sessions in statistics. The first of these sessions will run from June 9 through July 17, 1954. In addition to the courses previously announced in the December issue of *The American Statistician*, special statistical seminars will be given by the following speakers: R. A. Bradley, D. B. Duncan, G. L. Edgett, W. A. Thompson, Jr., P. N. Somerville, Gertrude Cox, Maurice Kendall, Ralph Comstock, W. A. Hendricks, Harold Hotelling, J. R. Stockton, H. H. Chapman, C. A. Bicking, Boyd Harshbarger, F. J. Anscombe, M. C. K. Tweedie, W. F. Callander, R. C. Bose, B. G. Greenberg, and James W. Johnston, Jr.

The Southern Regional Conference on Statistics under the chairmanship of Professor J. A. Rigney will be held June 28, 29 and 30 at the Virginia Polytechnic Institute in conjunction with the Statistical Summer Session. The members of this conference, approximately eighty in number, will be from southern institutions. A number of leading national statistical consultants from industry, colleges and government departments will also participate.

Summer Sessions at Iowa State College

Statistics courses will be offered at Iowa State College during the two six-weeks sessions of the 1954 summer quarter for the 29th consecutive year. This summer's offerings of the Department of Statistics are designed primarily for graduate students minoring in statistics and majoring in some other substantive subject-matter area, and for beginning graduate students majoring in statistics who may find it necessary to satisfy prerequisite requirements for the more advanced courses in statistics.

Senior staff members of the Statistical Laboratory and the Department of Statistics are available at least part of the summer quarter for consultations on special problems courses in statistics (Stat. 599) and on research connected with graduate theses (Stat. 699).

In addition, during the first six-weeks session (June 14–July 21), the following will be offered: Stat. 401—Statistical Methods for Research Workers; 411—Experimental Designs for Research Workers; 447—Statistical Theory for Research Workers. During the second session (July 21–August 27), the following will be offered: 402—a continuation of 401; 421—Survey Designs for Research Workers; and 448—a continuation of 447.

Summer Statistical Seminar at Storrs, Conn.

The fifth Summer Seminar in Statistics will be held at the University of Connecticut, August 9 through 27, 1954. This seminar is designed as a meeting place for statisticians with people in industry, commerce or the physical sciences. The plan is to have each day a morning and afternoon session of about two hours each. An invited speaker will introduce a topic which will later be the subject of general discussion.

The subject for the first week will be "Statistical Theories of Choice," with Professor David Blackwell of the Department of Mathematics, Howard University, Washington, D. C., the organizer. The second week will be devoted to "Applications of Statistics in Social Research," organized by Professor Walter Federer of the Department of Plant Breeding, Cornell University Agricultural Experiment Station, and "Applications of Statistics in Meteorology," organized by Professor Max Woodbury of the Department of Statistics, University of Pennsylvania. During the third week a joint session will be held with the Operations Research Society of America. Organizers for this session are Professor John W. Tukey, Princeton University, and Professor George Kimball, Department of Chemistry, Columbia University.

Anyone interested may attend for the day, week or the whole period. A registration fee of $2.00 per week or $5.00 for the whole seminar will be collected. Further information may be obtained from the Secretary, Professor Geoffrey Beall, Department of Statistics, University of Connecticut, Storrs, Conn.

Seminar-Conferences of the Foundation for Research on Human Behavior

Can business forecasters do a better job of predicting if they utilize psychological and other survey data? Research experts and professional forecasters studied this question at two seminar-conferences held at Ann Arbor, Michigan on January 22–23 and February 5–6, by the Foundation for Research on Human Behavior.

The conferences on "Using Economic Expectations and Intentions Data in Forecasting Business Conditions" appraised the predictive value of data from surveys developed since World War II, and sought ways of improving such survey data. Seventy-six persons participated in the two seminars, representing thirty-five business firms, including all of the major auto companies and a number of the largest oil, elec-

trical, rubber tire, chemical and public utility companies.

Doctors George Katona, John Lansing, James Morgan and Eva Mueller, of the Survey Research Center of the University of Michigan, led the discussion on theory, methodology and findings of surveys of consumer purchase intentions and expectations. Current surveys of business expectations and investment plans were described by Dr. Ralph J. Watkins, Director of Research for Dun & Bradstreet, Inc., and by Dr. Dexter Keezer, Vice President and Director of the Economics Department of the McGraw-Hill Publishing Company. Dr. Millard Hastay, of the National Bureau of Economic Research, and Dr. Jean B. Crockett presented some of their findings on the validity of business expectations and intentions data for shortrun forecasting.

Seminar participants exchanged their own experiences in using survey data in business forecasting, and questioned the speakers in detail about the methods, uses and limitations of the results of surveys of consumers and business men.

The Foundation's seminars are an integral part of its program of promoting the partnership of research and action agencies. The Ann Arbor seminar was the second in a continuing series on various topics. The first seminar was held last May, in New York City, and focused on recent research on supervisory and managerial behavior. The third seminar, also in two sections, is being held at the Corning Glass Center, Corning, New York, March 12 and 13, and at Ann Arbor, April 23 and 24. Its topic is "Leadership Patterns and Organizational Performance". Other seminars are now being planned on the following topics: "Channels of Communication", "Methods of Mediation of Disputes", "Investigation and Measurement of Attitudes", "Intergroup Relations in Organizations", "Validity and Usefulness of Measurements of Morale", and "How to Run a Conference".

Dr. Samuel P. Hayes, Jr., who acted as chairman at the January–February seminars, is Director of the Foundation for Research on Human Behavior. Dr. Hayes came to the Foundation last fall; he was formerly Assistant Director of the Mutual Security Agency, and earlier was Associate Director of the Marketing and Research Service of Dun & Bradstreet, Inc.

A report on the seminar on "Using Economic Expectations and Intentions Data in Forecasting Business Conditions" will be available at the office of the Foundation for Research on Human Behavior, 1141 E. Catherine Street, Ann Arbor, Michigan.

UN Statistical Yearbook

The United Nations has recently issued its 1953 "Statistical Yearbook," prepared by the U. N. Statistical Office with the cooperation of national statistical offices and the assistance of the specialized agencies of the U. N. and certain other intergovernmental bodies. This is the fifth in a series of such volumes, and is similar in content and arrangement to previous issues, but includes some new tables and additional detail or wider territorial coverage in the case of many of those previously published.

The "Statistical Yearbook, 1953" contains 182 tables, most of them covering the period 1933–1952 inclusive, though some also present data for the first half of 1953. Among them are tables on population, area and density of population; employment and unemployment; production of over 100 agricultural, mineral and manufactured commodities; levels of food-stuff supplies and consumption of energy, raw materials and fertilizers; construction; basic statistics on structure of manufacturing and mining; data on transport and communications; foreign trade data; summaries of national budgets and public debt statements; social security schemes; and statistics on housing, medical personnel, educational institutions, newsprint and newspapers, books, films and broadcasting.

The Yearbook may be purchased at $7.50, cloth-bound, or $6.00, paper-bound, from the International Document Service, Columbia University Press, 2960 Broadway, New York 27.

Openings for Statisticians at Iowa State College

A number of graduate assistantships and associateships in statistics are available for the 1954–55 academic year at Iowa State College for work connected with experimental design, theory and sample survey research. These include several Research and Development assistantships supported by the Iowa Agricultural Experiment Station to train students as statistical consultants in agricultural and biological areas. Assistantships are for 9 or 12 months and pay $125 a month. A variable number of available positions will be supported by current contractual research projects. Also there are openings for several assistants or associates (instructors) on the teaching budget of the Department of Statistics. Associates on half-time appointments for 12 months receive $1800; those on full-time, $3600.

For more information, write to the Statistical Laboratory, Iowa State College.

Statistical Training Center in Philippines

A Statistical Training Center will be opened in Manila by the Philippine Government with the cooperation of the United Nations Technical Assistance Administration. The Center, which is to be a permanent institution under the jurisdiction of the University of the Philippines, will provide instruction, demonstration and in-service training. One of its main objectives is the training of staff for the Philippine Government statistical services. Courses to be offered will deal with statistical methodology; sampling methods; organization and coordination of statistical services; collection, tabulation and publication of data; conduct of censuses; and analysis and utilization of statistics.

Two experts are being sent by the United Nations to assist in the establishment of the Center—Max Lacroix, who is temporarily assigned from the Population Division of the UN Secretariat, and Meredith Givens, who is on loan from the New York State Department of Labor, where he has served as Director of Research in Statistics, Division of Placement and Unemployment Insurance.

Sample Redesign and New Estimation Procedure for Current Population Survey

The Census Bureau has redesigned the sample for the Current Population Survey to reduce the sampling variability of the major estimates. A new estimation procedure also is being introduced which reduces the sampling variability for most important characteristics, primarily on month-to-month change. In addition—but to a smaller extent—the new estimation procedure reduces the sampling variability on estimates of level for a given month as well as on year-to-year change. Although most estimates will be more precise, a few may be slightly less precise than under the present estimation procedure.

These changes are discussed briefly below and will be discussed more fully in a forthcoming report on methodology in the "Bureau of the Census—Technical Papers" series.

Principal aspects and objectives of sample redesign

The principal aspects of the redesign are:

1. A change in the number of areas (primary sampling units) in the sample from 68 areas (comprising 125 counties and independent cities in 42 states) to 230 areas (comprising 453 counties and independent cities in 46 states). Thirty-six areas are common in part between these two independent samples.
2. The total number of households in sample continues at the present level (25,000), but is spread over the enlarged number of primary sampling units.
3. The period of enumeration is to be extended where necessary from the present 8 days to a maximum of 10 calendar days.
4. The district offices have been reduced from 63 to 34. The staff in these offices has been strengthened. The number of regional offices has been reduced from 7 to 5.
5. Work is proceeding on the development of a system of enumerator quality control to maintain performance at acceptable levels.

The purposes of redesign are: (1) to take advantage of better resources and improvements in the sample design in order to provide more information per unit of cost; and (2) to strengthen the accuracy of published statistics, to provide additional national statistics, to make possible regional statistics for summary characteristics, and to strengthen variance estimates made from the sample. A "dry-run" of the full 230-area sample took place in January 1954 and the present 68-area design was continued through February 1954. The results of the "dry-run" in January were, in general, similar to those in the 68 areas with the exception of the estimate of the number of unemployed which was significantly different. A news item in a subsequent issue of *The American Statistician* will discuss these and later results in more detail.

General description of the sample design

A multi-stage sampling design is used, similar in principle to the former 68-area design, but resulting in the selection of many more sample areas. Consequently the sample households are distributed more widely over the country than in the 68-area design. The redesign has the same expected proportion of sample households in each type of area—standard metropolitan areas, smaller urban areas and rural areas—as the 68-area design. The basic principles followed in the selection of the sample are as follows:

First, the entire area of the United States was divided into about 2000 primary sampling units. With some minor exceptions, a primary sampling unit (PSU) consisted of a county or a number of contiguous counties, such as those making up a standard metropolitan area. Each standard metropolitan area constituted a separate PSU. The primary sampling units were then grouped into 230 strata. The larger standard metropolitan areas were strata by themselves. In general, however, a stratum consisted of a set of primary sampling units, as much alike as possible in various characteristics such as geographic region, population density, rate of growth, percent nonwhite, principal industry, type of agriculture, etc. These are the same types of criteria used in the stratification of the 68-area design, although of course, more recent information was used. Except for the 44 largest standard metropolitan areas and 12 standard metropolitan areas near them, each of which is a stratum, the strata were established so that their sizes, in terms of 1950 population, were approximately equal.

Where a metropolitan area was a stratum by itself, it automatically fell in the sample. From each of the other strata, a single primary sampling unit was selected with probability proportionate to 1950 population. The resulting 230 areas are those in which the survey is being conducted.

Within each of the 230 areas, sampling rates were determined so that the sample is self-weighting. For the selection of the specific sample households, area sampling methods are used. Within each of the 230 primary sampling units, a sample of segments was selected, the segments containing, in general, an expected size of about six households. The households in these segments are covered by the survey. Where segments of about this size cannot be delineated, the households in a segment are sampled to result in an expected size of six households in the survey. The results of the 1950 Census, as well as the most recent and detailed maps available to the Census Bureau, were used in the establishment of the segments.

The effect of the new design is to reduce the standard error for the key statistics such as total labor force, nonagricultural labor force, agricultural labor force, the unemployed, and the total not in the labor force.

One of the basic requirements of the sampling design is the ability to measure the precision of the sample estimates from the sample itself. The fact that the old sample was limited to 68 areas has meant that measures of reliability have been inadequate for some important items. The expansion to the 230 areas makes possible the estimation of variances with much greater precision.

New estimation procedure

The new estimation procedure is:

$$z'''_u = K(z'''_{u-1} + z''_{u,\,u-1} - z''_{u-1,\,u}) + (1 - K)\,(z''_u)$$

where

z'''_u is the composite estimate for a given month, u

z'''_{u-1} is the composite estimate for the preceding month, u−1

z''_u is the estimate for month u based on the full sample, and on the present type of estimation procedure involving two stages of ratio estimates (i.e., race-residence based on 1950 Census county totals at the first stage and current independent estimates of age-sex-color groups at the second.)

$z''_{u,\,u-1}$ is an estimate for month u of the same type as z''_u except that it is based only on the households in the part of the sample common both to months u and u−1

$z''_{u-1,\,u}$ is an estimate for month u−1, of the same type as z''_u except that it is based only on the households in the part of the sample common both to months u and u−1.

K is a constant between 0 and 1.

The value of K is determined to satisfy the conditions that there will be some gain in reliability over the present estimation procedure for virtually all estimates. At the present, K equal to .5 satisfies this criterion for the major estimates.

JOSEPH STEINBERG, *Chief,*
Statistical Sampling Section,
Population and Housing Division,
Bureau of the Census

Intensive Review Committee's Appraisal of Census Programs

A final report has been submitted by the Intensive Review Committee appointed last October by the Secretary of Commerce to appraise the policies, procedures and programs of the Bureau of the Census. In the course of its rapid and intensive review, the committee consulted with Federal agencies and conducted a survey of national business organizations, trade associations, farm and labor organizations, and professional associations on uses of Census data. In addition, surveys were made for the committee by the American Marketing Association and the Trade Association Department of the Chamber of Commerce. Eleven panels of informed specialists were set up to submit recommendations to the committee on specific programs.

The committee's report, entitled *Appraisal of Census Programs*, contains 51 recommendations pertaining to population, agriculture, housing and construction, manufactures, mineral industries, business, transportation, foreign trade, governments, mechanical and electronic equipment, advisory committees, disclosure rule, leveling the workload, publication, professional staff, and sampling and related research. On censuses of industry, trade and agriculture, for which funds were disallowed last year by the Congress, the committee recommended that the complete Census of Manufactures, Census of Mineral Industries, and Census of Business, which had been scheduled for 1954 on 1953 data, be taken in 1955, covering 1954; that plans for a Census of Transportation be dropped pending further exploration of the feasibility of such a census; and that a complete Census of Agriculture be taken in the fall of 1954. The committee also recommended that a complete Census of Governments be taken in 1956, covering the year 1955.

Members of the committee were: Ralph J. Watkins (chairman), Director of Research, Dun & Bradstreet, Inc.; Murray R. Benedict, Professor of Agricultural Economics, University of California; John W. Boatwright, General Manager, Distribution-Economics Department, Standard Oil Company of Indiana; Stephen DuBrul, Executive in Charge, Business Research Staff, General Motors Corporation; S. P. Langhoff, Vice President and Director of Research, Young and Rubicam; J. A. Livingston, Financial Editor, Philadelphia Evening Bulletin; Myron S. Silbert, Vice President, Federated Department Stores; Lazare Teper, Director of Research, International Ladies' Garment Workers' Union; and Merrill Watson, Executive Vice President, National Shoe Manufacturers.

Copies of the report may be purchased, at 45 cents each, from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

REXFORD C. PARMELEE, *Executive Secretary,*
Intensive Review Committee,
Office of the Secretary,
Department of Commerce

Proposals regarding Statistics in Joint Economic Report

The Report of the Joint Committee on the Economic Report, issued February 26, contains a number of proposals regarding statistics, including announcement that the Chairman will appoint a Subcommittee on Economic Statistics:

> "On various occasions in the past the committee has indicated its great concern for adequate and accurate economic data upon which public and private policymaking may be founded with the maximum confidence. . . . The committee believes the problem of economic statistics is so important that it should pursue the study and analysis of available data even more vigorously than in the past. To provide the leadership and to supervise the activities of the committee in this whole area the chairman will appoint a Subcommittee on Economic Statistics."

The committee also directs its staff to sponsor an intensive review, in cooperation with the Council of Economic Advisers, the Bureau of the Budget and other agencies, of its monthly publication, *Economic Indicators*, to make sure that it fulfills the needs of the Congress for important and current economic data. It expresses a need for regular collection of more information on consumer incomes, expenditures and savings and consumer expectations, and concern over the consistency and accuracy of the various series relating to employment and unemployment.

The report includes a number of recommendations made by the committee staff to strengthen employment and unemployment statistics: (1) regular publication of an integrated report bringing together the information on the labor force, employment and unemployment collected by the Department of Labor (Bureau of Labor Statistics and Bureau of Employment Security) and the Department of Commerce (Bureau of the Census); (2) continuous research to reconcile differences in the several series of data and to make possible a better understanding and analysis of trends in employment and labor market conditions; (3) a rounded program to supply monthly information on the flows into and out of the labor force and on the character and location of the unemployed; and (4) study of seasonal influences upon variations in employment and the labor force, with emphasis also on measuring employment in terms of man-hours.

The committee endorses these recommendations and urges the Bureau of the Budget "to exercise its statutory authority to put them into effect." It also urges the appropriations committees "to recommend sufficient financial support for those and other statistical programs of the executive agencies."

Copies of the Joint Economic Report (83d Congress, 2d Session, House Report No. 1256) may be purchased, at 30 cents a copy, from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

GROVER ENSLEY, *Staff Director,*
Joint Committee on the Economic Report,
United States Congress

THE DESIGN OF EXPERIMENTS IN NAVAL ENGINEERING*

B. B. DAY

U. S. Naval Engineering Experiment Station, Annapolis, Maryland

(ILLUSTRATED BY R. W. MILLER)

Introduction

In every laboratory organization management problems are mainly concerned with means of controlling test work, such as the purchase of finer instruments, securing sufficient personnel, etc. However there will always remain a multitude of factors, each small in effect, which cannot be controlled. They may be due to environment, equipment, or operating conditions. These are the cause of variation in test data. (Figure 1.)

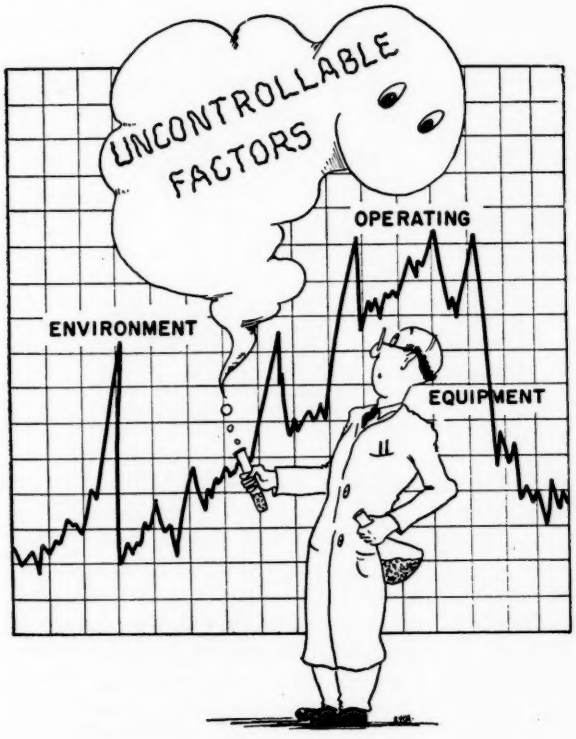

FIG. 1—Variation in Test Work.

Statistics is concerned with pertinent methods for dealing with this variation. By providing an actual numerical measure of the uncertainty, management is no longer forced to arbitrate differences among the technical staff as to the meaning of the test results. Using statistics, the conclusions are arrived at from a purely objective basis. Even the inexperienced engineer will be able to furnish the valid conclusions inherent in the data.

At the same time that Dr. Walter Shewhart and his co-workers at the Bell Laboratory were engrossed in developing statistical quality control methods, Professor R. A. Fisher was evolving principles of experimentation for more effective statistical research. This science of experimentation accomplishes two major tasks. It increases the reliability of answers and, at the same time, reduces the amount of testing required.

There are two aspects of the science. The first is concerned with *how* data are collected or, in statistical parlance, the Design of Experiments. The second has to do with the analysis and interpretation of the data and, while the importance of this phase cannot be too strongly emphasized, it is completely dependent on the first. Unfortunately, it has been a common practice for the investigator not to worry about the interpretation of the results until after an experiment has been run, only to find himself overloaded with data which do not give an answer to his problems. Dr. Condon has aptly expressed the heart of the scientific approach to experimentation: "In science, as well as in business, it pays to stop and figure things out in advance."

This paper presents a simple example to demonstrate the principles of experimental design. All possible factors of a test are integrated into a single coordinated plan where attention is paid to the order of scheduling

* This article is adapted from "The Use of Statistics in Planning Laboratory and Fleet Test Work" presented at the Bureau of Ships Directors' Conference (Oct. 1952). It appeared in the *Journal of the American Society of Naval Engineers* (May 1953) and is re-published with the permission of the author and that *Journal*.

of test runs as well as to the sampling problems involved. The example will show the advantage of this approach over the traditional "one-factor-at-a-time" method.

Principles of Statistical Planning

It is no secret that the United States must make a high bid for Near (Middle) East fuels should a major crisis arise. Even now some 1,300,000 barrels are being delivered to the Navy for almost exclusive use this year on the West Coast. But, because these fuels are of high sulphur content, a major problem is created, manifested in the severe wear of working parts, greater corrosion of the nonworking parts, increased sticking of piston rings, and dirty engines. This may mean high repair and replacement costs. It is, therefore, important to the Navy to study the effects of different content of sulphur in the fuel and to try to devise means of combating the detrimental effects.

A preliminary phase of this problem might be a laboratory test to compare the effects of two fuels of different sulphur content, one very high sulphur content, the other somewhat lower. Hence, the purpose would be to find if there is any difference in the effect of the two fuels, and if so, to measure how big the difference is.

Under the traditional method for running a test, the investigator would study only one factor at a time. In this case it would be the effect of sulphur content in the fuel, high sulphur against low. He would hold all other factors constant and vary the one, hoping to be able to keep the test conditions in control throughout the entire test.

He would start the test by getting a "good" estimate for the high sulphur fuel under normal operating conditions. He would appreciate the need for more than one run. If the cost were high, he might be able to make only one run with a check run. However, for the sake of the demonstration, let it be assumed that four runs were reasonable. When he has finished the high sulphur runs, he would change to low sulphur fuel, and repeat the number of runs. Thus, for the two fuels, he would have a total of eight runs.

He would then want to try out other things such as the effect of putting an additive into the lubricating oil or repeating the test under snorkel conditions. His second series might be an investigation of operating conditions. He would make the four runs with low sulphur fuels under snorkel, and the four runs with high sulphur fuel under snorkel. He would then have a total of 16 runs. There might be other series if the money holds out.

Thus, there would be four successive runs with high sulphur fuel, all other factors held constant, and four successive runs with low sulphur fuel under what was hoped to be the same constant conditions. A variety of different measurements would have been taken. The number of stuck rings will be used here for illustrative purposes since this would seem to be the simplest. The particular values entered are hypothetical.

For the high sulphur fuel, the four readings are 8, 10, 8 and 12, a total of 38 and an average of 9½. For the low sulphur fuel the four are 7, 9, 10 and 10, a total of 36, and an average of 9. On the basis of these data there would be little or no indication that sulphur content of the fuel affected the tendency of rings to stick.

However, the engineer would most likely not be altogether happy over these results. Since they were not decisive, he might even decide to take some more readings. Regardless of how well-controlled his test was set up, he does know that there will be numerous uncontrollable factors which would introduce errors into the test readings. Some of these could very well correspond to a regular pattern. The wear in the engine with use might be an example. This effect might become progressively accentuated as the testing continued and, *bias* would be introduced in the readings. (Figure 2). A bias, in the statistical sense, does not

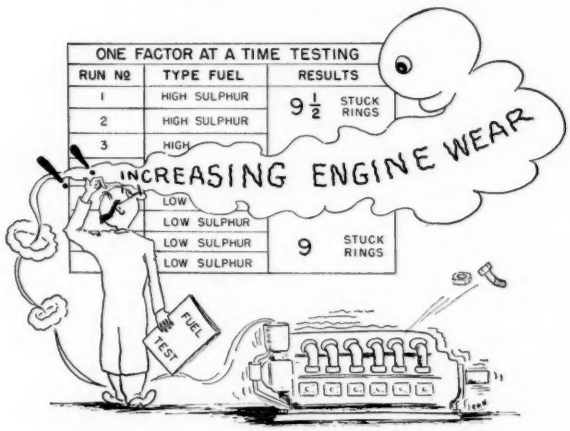

FIG. 2—One-Factor-At-A-Time Method of Testing.

pertain to an intentional influence on the data. Here, with all of the readings of one fuel completed before taking those for the second fuel, the effect of wearing in the engine could have been reflected in the readings of one fuel, thus hopelessly entangling a difference due to fuels with uncontrollable changes in test conditions. If the effect of progressive engine wear could have been measured and accounted for, the readings of low sulphur fuel could well have been 5, 6, 6 and 5, respectively, instead of 7, 9, 10 and 10, as given. There would also need to be some adjustment in the high sulphur readings. However, because of the order in which the readings were taken, there would be no possible way of evaluating

the adjustments for either fuel. What is true for this comparison will be even more so later when he attempts to use these two averages as standards against later testing, where uncontrollable factors may have caused considerable changes in test conditions. This situation makes it impossible to get a real measure of the error of the test, which is needed in all testing.

This test will now be planned statistically.

Step 1—*The Scope of the Test:*

The basis for preparing a statistical plan is two-fold. First is a concise formulation of the problem—that is, a clear definition of the engineering aims. This must be kept foremost in mind to insure that the test results can be used as intended. To insure that the test data will answer the problem, the procedure to be followed in analyzing the test data will be laid out before starting the test work.

The second important phase in the preparation of a plan is the use of background information which the investigator has accumulated. The numerous factors which may affect the results are listed. A decision is made as to the role that each shall play. The important factors will be the test variables, others will be held constant. The remaining factors, known and unknown, will be uncontrolled. Thus, using the above information, all of the possible factors are considered simultaneously and built into a single coordinated plan.

The purpose is as before. The pertinent factors are fuel oil, operating condition, and lubricant. In order to keep the problem simple, only the first two will be used, holding lubricant constant. In the actual plan, lubricant would have become a test variable as well. The two fuels, high and low sulphur, will be built into the plan; likewise two operating conditions, snorkel and surface. There are, therefore, four possible com-

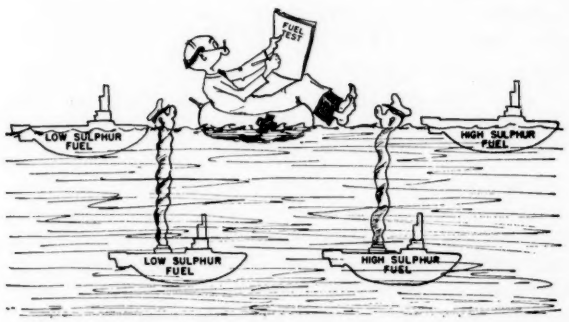

FIG. 3—Four Combinations of Two Fuels and Two Operating Conditions—Statistical Planning

binations of these two factors. (Figure 3). These are:

Low sulphur fuel	surface
Low sulphur fuel	snorkel
High sulphur fuel	surface
High sulphur fuel	snorkel

Step 2—*Replication:*

The reliability of the results is increased and a measure of the error of the test is provided by repeat observations. The next step will indicate the manner of making these repeats.

Statistics has borrowed the root work, "replica," to describe a complete run of all the combinations in a test, that is, a "replication." The first complete run is the first replication, the next the second replication, and so on. Two runs of the four combinations would give a total of eight readings, two replications, the same number as previously by the one-factor-at-a-time scheme. Ordinarily, the amount of repeat testing would be based on previous information as to the inherent variability in the test plus the cost involved. Lacking known information, a guess would be made and later revised or affirmed from the results in the testing to date.

It will be shown later that there are also two extra "hidden" replications of each fuel and operating condition.

Step 3—*Restrictions or Controls:*

By the one-factor method an attempt is made to control test conditions throughout the entire period of testing. By statistical planning, it is necessary to control the test conditions within only small parts of the entire period. All four runs of the first replication were tested as close together as possible. Not until after they were completed were any of the second set of four tested. It does not matter how much change may occur between the two replications, for such changes can be evaluated and eliminated from the error of the test. In fact, by running the test in two independent replicates of four each, instead of eight together, the experimental error may be definitely smaller. The reliability of the results can, in many instances, be greatly increased by the use of restrictions or controls. This is the basis of many ingenious experimental designs now available. While these designs result in considerable savings, the details cannot be presented here.

Step 4—*Randomization:*

It is only after all of the pertinent factors have been accounted for by careful planning that consideration is given to the uncontrolled factors. As has been emphasized, it is known that there will be uncontrolled factors present to cause variation in making any series of runs. One such factor in this problem is engine wear. To avoid bias in the results, the ideal would be to allot these effects among the several individual runs in such a way as not to favor any one over another. There is no exact method for doing this since many factors are unknown. Therefore the way would be to select the order of run by chance—that is, in a random manner. (Figure 4).

This principle of randomization, one of the essential features of statistical planning, must be an integral

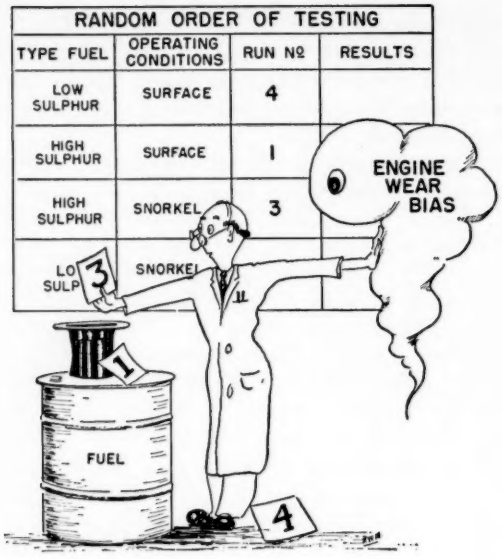

FIG. 4—Random Selection.

part of every test for the conclusions to be valid. It does two things. It is insurance against bias in the results for particular factors and it makes valid the computation of the numerical measure of the random variation called experimental error. Being able to estimate his experimental error is of tremendous importance to the meticulous investigator who must know how good his answer is.

Just how the randomizing operation enters into the plan of a test depends upon the basic information furnished by the investigator as to conditions peculiar to the particular investigation. An important consideration in this respect would be the cost involved. Experience has shown that the requirements for randomization can be fulfilled at little or no additional cost.

In this example the random selections were made by assigning the numbers 1 to 4 to the four combinations and making two independent draws from a table of random numbers. Below are the two orders actually gotten.

Order of testing	*First replication*	*No. stuck rings*
1	Low sulphur, surface	4
2	High sulphur, surface	5
3	High sulphur, snorkel	8
4	Low sulphur, snorkel	6

Order of testing	*Second replication*	*No. stuck rings*
1	High sulphur, snorkel	12
2	Low sulphur, surface	5
3	Low sulphur, snorkel	7
4	High sulphur, surface	7

There are two complete replications or repeats with the order of testing randomized within each.

Step 5—*Information Available From Test:*

As stated before, an integral part of the plan is the layout of the analysis to be made on the test data. The procedure for this is a very powerful tool of statistics, the Analysis of Variance. It will yield the maximum amount of information inherent in the observational data of a properly-planned test in a completely objective manner. In fact, it was this technique which made it possible to put the several important factors into a single coordinated plan and get out all the information in the data. Only a very general approach will be given now.

Using the same measurement as before, the number of stuck rings, the available information from the eight readings will be outlined.

(a) Experimental Error.

The first piece of information would be the experimental error, that is the error of the test. This is needed as the tape measure for judging whether the numerical differences between fuels are significant.

There were two readings made at each of the four conditions. The difference between these two readings, will yield a measure of the uncontrolled element of variation, or the experimental error.

(b) Comparison of Fuels.

The next interest would be in the two fuels. There were two runs of high sulphur fuel at snorkel and two runs of high sulphur fuel at surface. Similarly, there were two runs of low sulphur fuel at each of these operating conditions.

These can be arranged in tabular form, adding the two in each case from the two replications.

No. of runs		*Total no. rings stuck*
2	high sulphur, snorkel	20
2	high sulphur, surface	12
–		—
4		32
2	low sulphur, snorkel	13
2	low sulphur, surface	9
–		—
4		22

Here the fuels are balanced as to operating conditions, each having two runs at snorkel and two at surface. Therefore the difference between the two totals will be due to the fuels except for experimental error Here the difference is $32 - 22 = 10$. This amount can then be compared to the experimental error and the probability that the two fuels have an inherently different effect on rings can be determined.

Note that the two averages from these totals of four are equally as good as were those by the one-factor-at-a-time method. This illustrates a very favorable characteristic of this method of planning.

As previously mentioned, hidden replications are available. While there were only two complete replications of the conditions, the estimate of each fuel here is based on four. Moreover, each additional factor introduced into an experiment means additional replications of the factors already in the test; thereby increasing the precision of their estimates by hidden replications. This multiplies rapidly with several factors.

(c) Comparison of Operating Conditions.

The effect of operating conditions can also be compared because they are balanced as to fuels. This would be the total of the first row of the two section of the table above against that for the second row, using the same set of data. Again these totals of operating conditions are based on four readings each. The difference between these over and above random error will be due to operating conditions. The difference here is 12. Applying the same reasons as for fuels, the significance of this difference would be available. This was not available from the eight readings of one-factor-at-a-time test.

(d) Interaction.

But that isn't all. A third piece of information is available. That is whether the high sulphur fuel is equally detrimental at both operating conditions. At snorkel the difference was seven ($20 - 13 = 7$), while at surface the difference was three ($12 - 9 = 3$). The excess at snorkel is then four ($7 - 3 = 4$). Whether or not this value of four represents a real difference in effects depends, as in the other comparisons, on the value of the experimental error. This kind of information is called *interaction*. There is an interaction when the effect produced by one factor is modified by changes in the other. Here, it would be that the increased effect of high sulphur fuel over low sulphur in causing rings to stick is accentuated under snorkel conditions. It can be said that there is a joint or interaction effect of fuel and operating condition. This information would not have been available from the first way of testing.

The advantage statistical planning has in furnishing a means of measuring the interacting effect of two factors cannot be too strongly emphasized. Information as to the possible interactions of the factors will often be the most important item. For example, noise may not increase when running at a low speed with changes of the temperature of the lubricating oil, while at high speed the effect may be radically different as temperature changes.

Since the two replications are completely balanced as to fuel and operating condition, the difference in their averages, over and above random error, will be due to replication. Such a difference would be caused by large changes in test conditions, which might be associated with length of time elapsed, such as engine wear, temperature and instrument change. This comparison might be substantial. If there had been a real change in test conditions, taking this comparison out would give a smaller estimate of the experimental error. The smaller the experimental error, the more sensitive will be the test and smaller real differences between means can be detected. This is one very important way of increasing the reliability of a test, quite unknown and impossible to the one-factor-at-a-time investigator. Thus, the total of first replication, minus the total of second, would be $(4 + 5 + 8 + 6) - (12 + 5 + 7 + 7) = 23 - 31 = -8$. As in previous comparisons, the importance of this difference will be measured against the experimental error.

At this stage, we can recapitulate our information from these eight readings.

	Comparisons
Replication, first vs second	1
Fuel, high sulphur vs low sulphur	1
Operating condition, snorkel vs surface	1
Fuel by operating condition, interaction	1
Experimental error	3

Advantages in Statistical Planning Over One-Factor-at-a-Time Method

Stock may now be taken on the two ways of running

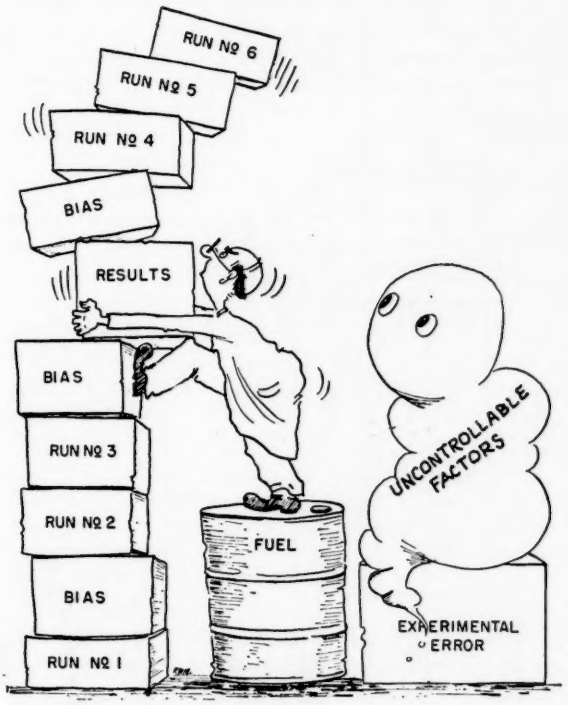

FIG. 5—Results With One-Factor-At-A-Time Testing.

a test, basing it on eight pieces of data in each case.

Results From Eight Runs by Each Method

One-Factor-at-a-Time	*Statistical Planning*
Averages of the two fuels based on four readings possibly entangled with biases from changes in the test conditions.	Averages of two fuels based on four readings free from bias.
	Average of effect of two operating conditions based on four readings free from bias.
	Interaction effect evaluated of fuel and operating condition.
And that is all.	
	A measure of experimental error.
	Broad base for conclusion. (High sulphur fuel under different operating conditions.)
No real basis for conclusion.	

The remarkable difference in the information available from the two methods of running the test is certainly a selling point for the scientific approach. By the one-factor-at-a-time method the investigator ends up with very unsure, unstable results. The uncontrolled factors have introduced bias and have completely spoiled the measure of the experimental error. (Figure 5). On the other hand with statistical planning a single coordinated plan is followed which makes it possible to measure the experimental error and furnishes him the results in a beautifully tied-up package. (Figure 6).

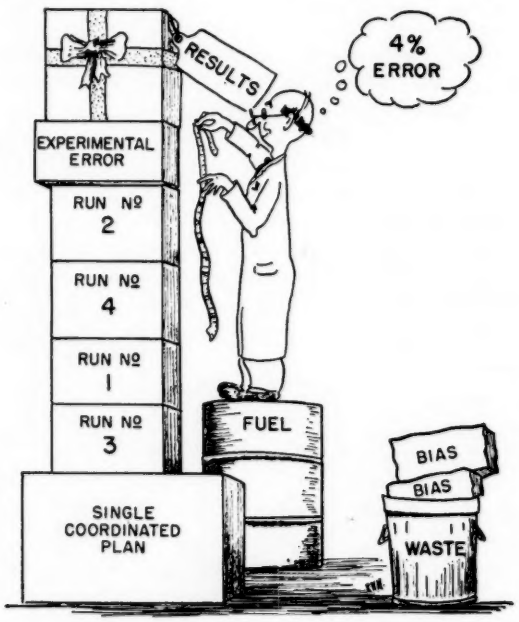

FIG. 6—Results With Statistical Planning.

For purely demonstrational purposes, the example was limited to two factors each at two levels. As the number of factors and the levels of each increase, the advantages of statistical planning multiplies progressively. Lubrication could have been included say at two levels—low additive and high additive—so that at the same time information was becoming available on what high sulphur fuel was doing to the engine, preventive measures could also have been studied.

With a well-thought out plan, it is logical to assume that testing will be at a minimum to meet the requirement in contrast to what is often "a long series of overlapping, inconclusive meanderings." There is economy in the fact that the statistically-planned test with the same number of runs, provided definite answers as compared to indecisive ones by the one-factor-at-a-time scheme. It has been shown how the eight observations were used in a number of different ways to furnish sets of totals. This reworking is most economic by furnishing additional hidden replications.

But, it is possible, in some cases, to effect even greater savings by reducing the amount of testing through restrictions or controls. The basis for this type of planning will be the initial background information furnished at the first stage of the program. Thus, on the assumption of no interaction present, and using certain restrictions or controls, the desired information can be obtained with only a fraction of the observations required for even one complete run of all combinations. Often computed interaction effects, when not significant, may serve as an estimate of experimental error so that only one complete replicate is required. Savings of this sort can be greatly multiplied. There are many formal statistical plans available today to cover a variety of situations.

By no means the least advantage to be derived from statistical planning is the fact that it requires the investigator to completely think his problem through before starting the test work. This is invaluable..

Statistical planning differs chiefly from the one-factor-at-a-time scheme in that:

(a) Instead of studying the factors piecemeal, one-at-a-time, they are all contained within a single coordinated plan. In fact, this consideration of all pertinent factors simultaneously is the distinguishing characteristic of statistical planning.

(b) Randomization is used to insure against bias in results.

(c) Using certain well-defined restrictions (or controls), the amount of testing is reduced, but the reliability is increased.

Continued on Page 23

ANALYZING BUSINESS CYCLES*

GEOFFREY H. MOORE

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No royal road to economic forecasting has yet been charted. But economists have been busy evaluating each other's methods, and in the process they are gradually learning more about the behavior of the economy. If scientific investigation can command the resources needed to keep up with the continual changes in economic behavior and development of our institutions, the prospects for better economic foresight will be bright.

In recent months many people have been wondering whether a business recession is in the making. It may be useful, therefore, to describe one approach to this question and review its recent history. At the same time I should like to describe some experimental work with another approach.

The first approach is based on the fact that different types of economic activities move in a fairly systematic sequence during business cycles. In "Statistical Indicators of Cyclical Revivals and Recessions" (*Occasional Paper 31*, National Bureau of Economic Research, 1950) I set forth a list of 21 economic time series that possess two useful characteristics from this point of view, and hence warrant the attention of the business cycle analyst. First, their cyclical swings regularly matched past business cycles—namely, before 1939. Second, they either led, coincided with, or lagged consistently behind general business movements—again, before 1939.

There are many reasons why some economic time series, even those that are clearly relevant to an analysis of current business trends, do *not* possess the two characteristics mentioned, or do so in relatively small degree. Total federal expenditures is one of these; commodity exports is another. Federal expenditures are governed by many considerations that are remote from the current business situation and unless the changes in such expenditures are large, they do not exercise a dominant influence on business. The total volume of exports is determined in part by the extent of our crop surpluses and by the economic well-being of the countries to whom we export, and hence may undergo fluctuations that are erratic relative to business activity in this country. Such series are excluded from our basic list, though this does not mean they should be ignored, as I shall indicate later.

On the other hand there are many reasons why some economic time series *do* possess the characteristics mentioned. Series of broad economic coverage are likely possibilities—narrow coverage may mean that special circumstances will frequently cause divergence from the general movement. Some activities are tied to others but with a lag. A rise or decline in new orders or contracts for goods that take a long time to produce, such as locomotives or houses, is likely to generate a similar change in the volume of activity of these industries, with a lag. The money market may get tighter for some time before banks raise their interest rates to customers. In many industries an increase in the average work week is likely to occur before the number of persons employed advances. Months may pass before a decline in the price of a raw material is reflected in the prices of finished products.

For these and similar reasons a systematic search of economic data is likely to yield a number of different types of series that usually move ahead of the business tides advancing and receding upon the economic shore, as well as a number that lag behind. The 21 indicators are the result of such a search. As I have said, they were selected on the basis of the behavior they, or their historical equivalents, exhibited during business cycles before 1939. The record examined was primarily a peacetime record. Unfortunately, the years since 1939 have not been peaceful, and war does strange things to the economy and to the statistical series that reflect its processes. Nevertheless, something akin to a peacetime economy was restored in 1946–1949, and at least all-out war has been avoided since. At any rate in considering the usefulness of this collection of indicators, we have no choice but to examine the record since 1946.

Chart 1 records the 21 series (for sources of current data, see Table 2). The regular intra-year seasonal variation that most series undergo has been eliminated where present in the original data, a time-consuming but indispensable statistical operation. The asterisks identify, so far as possible, the cyclical peaks and troughs in the series, according to a standard procedure.

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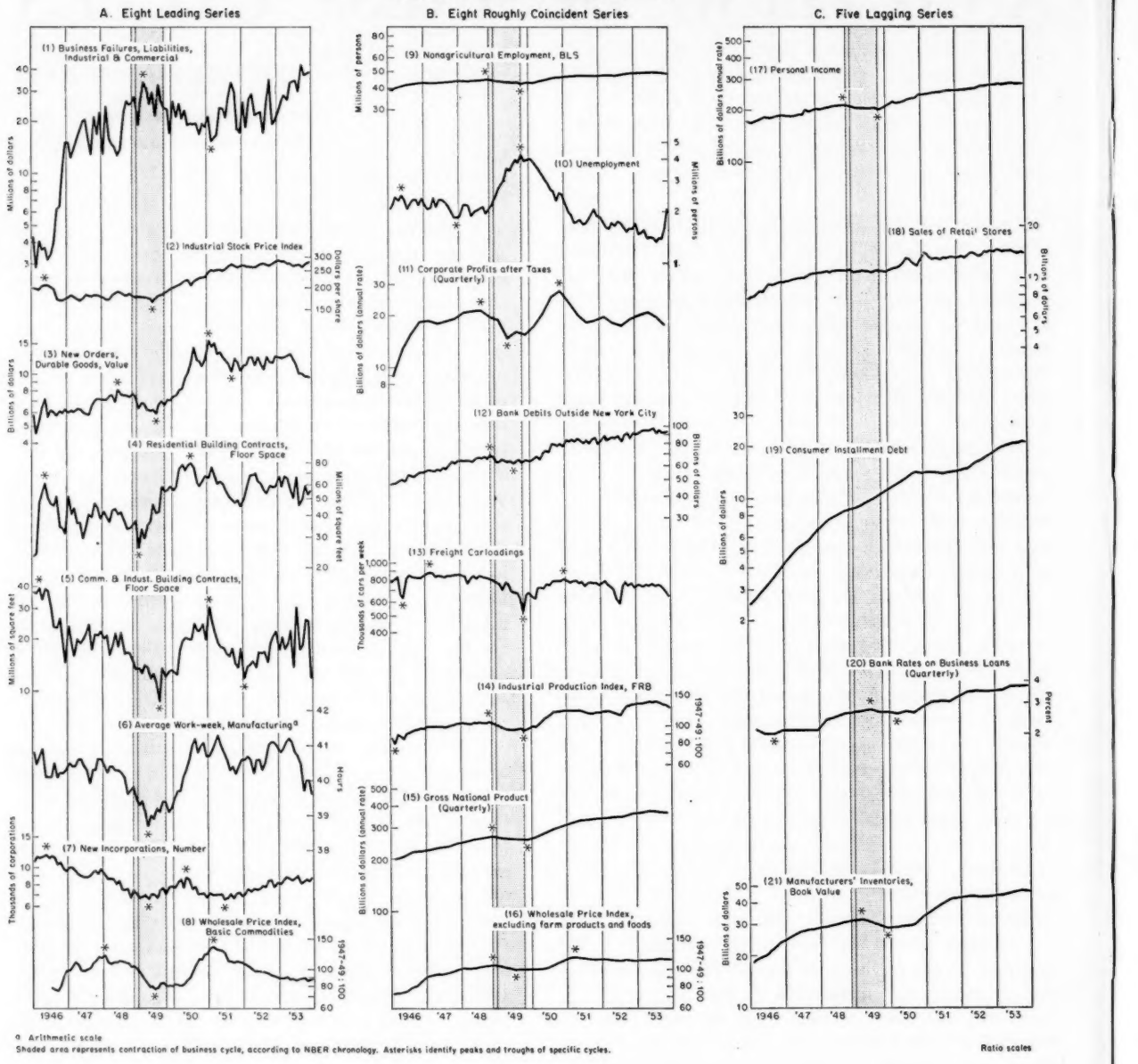
Chart 1

Twenty-one Statistical Indicators, 1946-53


A. Eight Leading Series
B. Eight Roughly Coincident Series
C. Five Lagging Series
(1) Business Failures, Liabilities, Industrial & Commercial
(2) Industrial Stock Price Index
(3) New Orders, Durable Goods, Value
(4) Residential Building Contracts, Floor Space
(5) Comm. & Indust. Building Contracts, Floor Space
(6) Average Work-week, Manufacturing[a]
(7) New Incorporations, Number
(8) Wholesale Price Index, Basic Commodities
(9) Nonagricultural Employment, BLS
(10) Unemployment
(11) Corporate Profits after Taxes (Quarterly)
(12) Bank Debits Outside New York City
(13) Freight Carloadings
(14) Industrial Production Index, FRB
(15) Gross National Product (Quarterly)
(16) Wholesale Price Index, excluding farm products and foods
(17) Personal Income
(18) Sales of Retail Stores
(19) Consumer Installment Debt
(20) Bank Rates on Business Loans (Quarterly)
(21) Manufacturers' Inventories, Book Value
1946 '47 '48 '49 '50 '51 '52 '53

a. Arithmetic scale

Shaded area represents contraction of business cycle, according to NBER chronology. Asterisks identify peaks and troughs of specific cycles.

Ratio scales

The 21 series are divided into three groups according to their average timing at business cycle turns prior to 1939. Each of the eight series in the "leading group" has usually turned down early in a business recession and turned up early in a revival; each of the eight in the "roughly coincident group" has usually turned somewhat later—within a month or two of what we take, on the basis of detailed study of these and other statistics, to be the business cycle peak or trough; each of the five in the "lagging group" has usually kept on declining until the revival is well under way and kept on rising until the recession is well-advanced. Table 1 gives the average number of months that the peaks and troughs in each series lead (−) or lag behind (+) the business cycle peaks and troughs. These averages cover the entire historical record of the series up to 1939, which in some cases means several decades, in other cases only a single decade.

TABLE 1

Cyclical Timing of 21 Indicators[a]

Series	Lead (−) or Lag (+) in Months at Business Cycle Peaks and Troughs			
	Average before 1939		At Nov. 1948 Peak (3)	At Oct. 1949 Trough (4)
	At Peaks (1)	At Troughs (2)		
Leading Group				
1 Business failures	−10.5	−7.5	[b]	−7
2 Stock prices	−6.0	−7.2	−30	−4
3 New orders	−6.9	−4.7	−5	−3
4 Residential contracts	−6.2	−4.5	−30	−9
5 Commercial contracts	−5.2	−1.7	−32	−2
6 Work week	−3.8	−2.6	[b]	−6
7 Incorporations	−2.5	−3.5	−30	−6
8 Basic prices	−2.6	−3.2	−10	−4
Roughly Coincident Group				
9 Employment	−0.2	−3.3	−1	0
10 Unemployment	−1.5	+1.0	−11	0
11 Profits	−1.5	−1.8	−3	−5
12 Debits	+2.0	−4.3	0	−3
13 Carloadings	−0.3	−1.3	−21	0
14 Industrial production	+0.6	−2.2	−1	0
15 GNP	+2.5	+0.5	0	+1
16 Wholesale prices	−3.5	+3.7	0	−3
Lagging Group				
17 Personal income	+4.0	−0.2	−1	0
18 Retail sales	+3.8	+1.8	[b]	[b]
19 Installment debt	+5.0	+3.5	[b]	[b]
20 Rates on loans	+5.5	+4.8	+7	+5
21 Manufacturers' inventories	+6.5	+7.5	+4	+2

[a] See *Occasional Paper 31*, Tables 1 and 12, for the business cycle chronology, the historical series used for the timing record, and the periods covered before 1939. For series 10 (columns 1 and 2) we here use the unemployment estimates of the National Industrial Conference Board, 1929–1938; for series 15, we use new quarterly estimates of gross national product by Harold Barger and Lawrence Klein, 1921–1938. Series 1 and 10 (business failures and unemployment) are compared invertedly with business cycles—that is, troughs in the series are compared with business cycle peaks, and peaks with business cycle troughs.

[b] No corresponding turn.

The table also enables us to compare this prewar record with experience in the 1948–1949 business recession. In column 3, the date of the peak in each series is compared with the business cycle peak, which we take to be November 1948, and in column 4 the troughs are compared with the business cycle trough, October 1949. Thus the entry −10 and −4 for series 8 means that the peak in the index of basic commodity prices occurred in January 1948, ten months before the business peak, while the trough was reached in June 1949, four months before the business trough (cf. Chart 1).

One must conclude, I think, that the pre-war record provided at least a rough guide to the post-war behavior of these series. Or, to put it differently, the sequence of cyclical turns among these series at the 1948 peak and at the 1949 trough was roughly similar to the usual sequence before 1939.

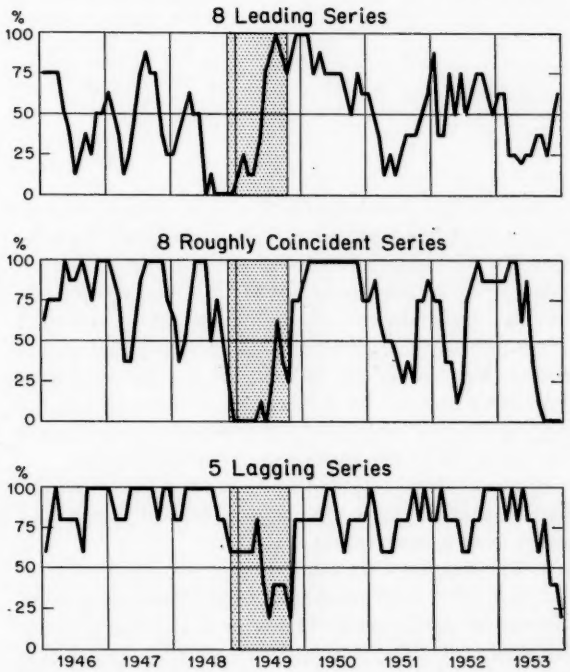
However, the correspondence, especially at the 1948 peak, is no more than fair. Several of the leading series began declining long before the peak, and two of the lagging series did not contract at all. But a reading of the pre-war record discloses similar divergences in earlier cycles. The *condition* is not new, though the precise way that these variations manifest themselves from cycle to cycle is a problem that seems to have no simple solution.

A Summarizing Device

The problem of variability must nevertheless be dealt with, and one way of doing so is to consider broad groups instead of individual series. Just as in everyday affairs, the individual is more variable than the group. Chart 2 demonstrates a scheme for combining our three groups of series into three indexes of cyclical status—the percentage of series undergoing expansion. When this percentage is below 50, more of the series are contracting than are expanding; when it is above 50, more are expanding than are contracting. It is a simple device for indicating the consensus among the movements of a group of series.

Chart 2

Percentage of Series Expanding
Three Groups of Indicators, 1946–53



Shaded area represents contraction of business cycle, according to NBER chronology.

Such a percentage might be computed by counting how many series rose this month compared with last month. Because of the choppy character of most of the series and the small number in a group, this figure would be quite erratic. Instead, we have first smoothed the series by means of moving averages, using longer moving averages for the more erratic series, and have based the percentage expanding on the direction of change in these centered moving averages.

The moving average periods (in months), in the order in which the series appear in Ch rt 1, are: leading group—6, 4, 6, 6, 6, 4, 6, 3; roughly coincident group—2, 5, 3, 6, 5, 2, 3, 2; lagging group—2, 4, 1, 3, 1. The one-month moving averages indicated for series 19 and 21 mean that the original (seasonally adjusted) data are used. The three-month periods indicated for the quarterly series 11, 15, and 20 mean that monthly observations are obtained by straight-line interpolation between the quarterly data, series 11 and 15 being centered on the mid-month of the quarter, series 20 on the last month of the quarter. The centered moving averages may be brought "up-to-date" by extrapolating the last available month of data. In practise, none of the moving averages need be computed since the only information required is their direction of change, and this may be inferred by comparing appropriate months of original data, as shown in the following scheme:

Period of Moving Average (mos.)	Months Compared	Month in Which Direction of Change Is Entered
1	1st & 2nd	2nd
2	1st & 3rd	2nd
3	1st & 4th	3rd
4	1st & 5th	3rd
5	1st & 6th	4th
6	1st & 7th	4th

One visible result is that although in terms of original data most of the leading series are more erratic than the roughly coincident or lagging series, the per cent expanding is hardly more erratic for one group than another. Nevertheless, in reading the curves one must remember that a decline from 100 to 75 per cent simply means that 2 series out of 8 (in the leading or roughly coincident groups) have begun to decline; and in the lagging group a similar shift in the behavior of 2 series (out of 5) shifts the percentage from 100 to 60.

Study of these and similar curves for earlier periods (see *Occasional Paper 31*) suggests several points that aid in their interpretation.

1. The roughly coincident curve generally reaches 50 per cent on or near the month when there is a general reversal of the business tide—a peak or trough of the business cycle. The leading curve usually reaches this point a few months earlier, and the lagging curve a few months later.

2. The above observations should be qualified because, although since 1946 the average level of the leading curve has been about 50 per cent, the average level of the roughly coincident curve has been somewhat above 50 per cent (65 per cent during 1946–1953), and that of the lagging curve well above 50 per cent (80 per cent during 1946–1953). This tends to make the lead of the leading curve (at the 50 per cent point) longer at peaks than at troughs, and to make the lag of the lagging curve longer at peaks than at troughs.

3. Since 1946 the leading curve has crossed the 50 per cent line from above on several occasions (mid-1946, early 1947, late 1947, early 1951) when no generally recognized business recession has followed. The roughly coincident curve has usually shown corresponding movements, dipping briefly below the 50 per cent line, and sometimes an extra movement, as in 1952 in connection with the steel strike. But the lagging curve did not participate in these "abortive recessions." Only in 1948–1949 did all three curves drop substantially below 50 per cent and remain there for several months.

The moral of point 3 deserves elaboration. A substantial business recession or revival has seldom if ever been "missed" by these curves. That is, if a recession or revival is under way, the curves will have "signaled" it, and in the order indicated.

But one or another of the curves may set false signals of recession, just like the individual series on which they are based. To distinguish the "genuine" from the abortive recession or revival it is well to look at all three curves, not just one. If all three participate in a given movement the evidence that a genuine revival or recession is under way is stronger than if only one, or even two participate.

Genuineness is also indicated by the depth or height of the curves, and by the length of time they remain at an extreme level. For example, in the abortive 1946, 1947, and 1951 movements, the leading and roughly coincident curves either did not go to extremely low levels, or ventured there only a month or two; and the lagging curve did not participate at all. Even the 1948–1949 recession was a relatively mild affair. In the Great Depression of 1929–1932, similar curves reached very low levels late in 1929 and stayed there until mid-1932 (except for a brief and mild rise early in 1931).

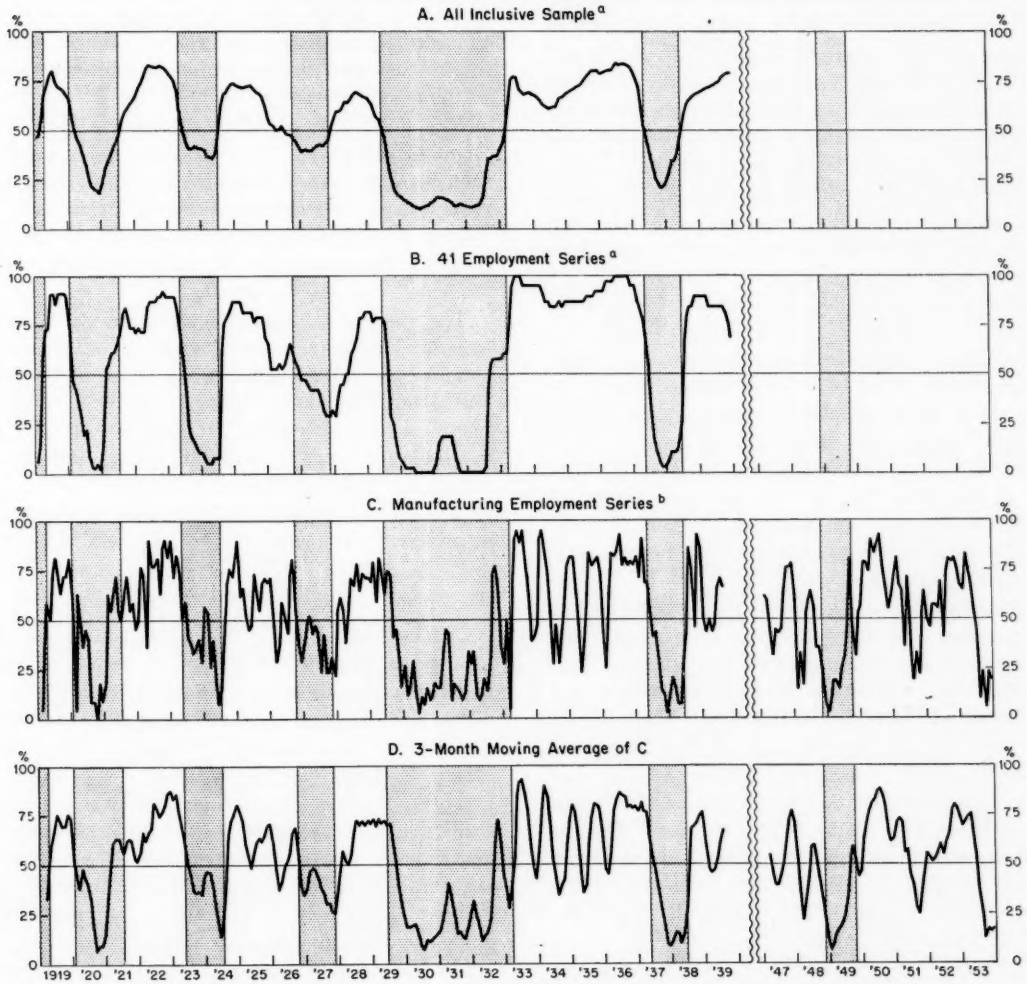
4. The percentage-expanding curves are mechanical summaries of the economic actualities represented by the series on which they are based. This is one of their strong points, but it is also a weakness. These curves are aids to, not substitutes for, careful study and analysis of the underlying data.

They do not answer such questions as: Is an improper seasonal adjustment depressing the current level of a series unduly? Is a strike, the anticipation of a strike, or the recovery from a strike having an appreciable effect

one one or more series? Is a given series, such as freight carloadings, affected by a long-run downward trend peculiar to that industry? Is a new government regulation or the repeal of an old one specifically affecting a certain sector? Does an alternative measure of employment, or prices, or profits, or incomes show the same movement, and if not which is more accurate? Is the movement in a given measure of "business activity" due to erratic changes in one or two components or is it a widespread and continuing change?

Then there are broader and more intricate questions. Is a rise in interest rates, consumer credit, wage rates, or inventories a favorable or an unfavorable development at the current stage of the cycle? Are government expenditures increasing or decreasing so rapidly that they are likely to overbalance any contrary tendency the private economy may itself generate? What moves have the monetary authorities made that will affect the money supply or the demand for funds? What other policies of a pro- or anticyclical nature have been or are about to be adopted? Neither the narrower nor the broader questions are academic. Their due consideration has prevented mistakes in the past and will do so in the future.

Chart 3
Percentage of Series Undergoing Expansion, 1919-53


A. All Inclusive Sample [a]
B. 41 Employment Series [a]
C. Manufacturing Employment Series [b]
D. 3-Month Moving Average of C
%
100
75
50
25
0
1919 '20 '21 '22 '23 '24 '25 '26 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '47 '48 '49 '50 '51 '52 '53

[a] Expansion measured by specific cycles See Arthur F Burns, *The Frontiers of Economic Knowledge* (Princeton University Press, 1954), p. 115.
[b] Expansion measured by month-to-month changes.
Shaded areas represent contractions of business cycles, according to NBER chronology.

Diffusion of Cycles

The statistical devices presented above are useful distillations of experience, I believe, but they concentrate upon only certain aspects of past experience and they reflect only certain aspects of present-day events. Other aspects, as the above questions indicate, may be equally relevant and useful in arriving at a sound judgment of economic prospects. To illustrate this point further let us consider one of the questions in the above list—whether or not the movement in business activity is widely diffused—since it leads to some interesting posibilities that constitute the second approach referred to at the outset.

Chart 3 tells the story. Again we use the percentage of series undergoing expansion, but here we ignore systematic differences in the timing of series. The purpose is to show how widely diffused throughout the economy, or within any one sector of it, a particular cyclical expansion or contraction is. The significance of such a measure was suggested by Arthur F. Burns and Wesley C. Mitchell in their volume, *Measuring Business Cycles*. They found that cyclical diffusion is a fairly sensitive index of the severity or amplitude of a business cycle phase. If our present hopes are realized, it may be possible to provide a reliable measure of diffusion at an early stage in a revival or recession, and thus learn quickly the strength of the forces operating to produce an upswing or downswing.

Curve A, which was constructed by Burns from the cycles identified in the National Bureau's extensive collection of time series (nearly 700 series were utilized), is a conglomerate of all types of economic data—production, prices, interest rates, inventories, and so on. Series that conform poorly to the business cycle as well as those that conform well are included, and leaders as well as laggards. But since it embraces so many aspects of business this conglomerate is one of the best historical indexes of the cyclical position of our economy that has ever been devised.

Notice that the curve dips below the 50 per cent line at the beginning of each business cycle contraction and rises above it at the beginning of each expansion. What is more important, as Burns pointed out in a recent report ("Business Cycle Research and the Needs of Our Times," *33rd Annual Report* of the National Bureau of Economic Research, reprinted in *The Frontiers of Economic Knowledge*, by Arthur F. Burns, Princeton University Press, Feb. 1954), is that the curve dips far below 50 per cent in the first few months of the severe depressions of 1929–1932, 1937–1938, and 1920–1921, but only slightly below 50 per cent in the mild depressions of 1923–1924 and 1926–1927.

The series that comprise curve A do not add up to any easily defined aggregate. What happens when we confine the sample to a single type of series, such as employment, is revealed in curve B. The general configuration is similar to A, but B reaches farther toward the extremes of 100 and 0, is somewhat more erratic, does not fit the business cycle chronology so closely, and does not distinguish the mild from the severe cycles so accurately. Limiting the curve to a single sphere or aspect of business activity does not seem to improve its properties for the present purpose, though the sheer difference in number of series included is partly responsible for the difference between curves A and B.

Curves A and B are both based on cycles identified in the individual series. That is, cyclical turns are marked on a chart of each series (see the asterisks in Chart 1), and a series is said to undergo expansion in every month between a trough and the subsequent peak, and to undergo contraction in every month from a peak to the following trough. Now this is all very well for historical analysis where one can see the whole sweep of a series, but it is not much use in defining its current status, since the perspective that will be provided by its future course is beyond our view. This means that cycle turns cannot so readily be identified at the time they occur.

As a substitute, we have experimented with a simple count of the number of series that rise (or fall) from month to month. Although in an individual series this is ordinarily a very inexact way of identifying its cyclical status, in a large sample of series many of these irregularities cancel out, so that the broader cyclical movements can be discerned.

The result, when we confine the sample to the major industrial components of the Bureau of Labor Statistics index of manufacturing employment, is curve C, and a mechanical smoothing of it by a three-month moving average is curve D. The number of components available for curve C varies: 11, 1919–1922; 21, 1923–1928; 22, 1929–1939; 21, 1947–1953. The percentage expanding is computed from month-to-month changes in seasonally adjusted data for each component series.

Further Research

Curves C and D are rather imperfect replicas of their prototypes, A and B. But they do bear a resemblance and the approach seems promising. Experiments with other data compiled by the Bureau of Labor Statistics, the Federal Reserve Board, Dun & Bradstreet and other agencies—on production, wholesale prices, corporate profits, etc.—are going forward. And statistical techniques that may help to distinguish the longer and wider swings are being explored. The result may be a general index of cyclical diffusion, or a set of such indexes, sufficiently up-to-date to be useful, reliable guides to the strength of economic trends.

Indexes of diffusion, and statistical indicators in general, will not in themselves solve the problem of business cycle forecasting, though they may help to do so. Much work remains to be done to reveal the limits

within which they are reliable, and the reasons why they behave as they do. In these days of sudden war and sudden peace, and of potential governmental anticyclical policy, the "best" forecasts may well come to naught. But it cannot be doubted that intelligent decisions, both public and private, require up-to-date objective analyses of the business situation and its prospects, apart from the potential impact of government and the international situation. If the development of such tools as we have described contributes to that end, the effort will not be wasted.

TABLE 2

Sources for Twenty-One Indicators

1. *Current Liabilities of Industrial and Commercial Failures*
   Dun & Bradstreet, Inc., *Dun's Statistical Review* and advance monthly press release, "Business Failures." Seasonal adjustment by NBER.
2. *Index of Industrial Stock Prices, Dow-Jones*
   Barron's National Business and Financial Weekly. Monthly average of daily closing prices. As a preliminary estimate of the current monthly average, the daily figure for the trading day on or nearest the 15th of the month may be used. No seasonal adjustment necessary.
3. *Manufacturers' New Orders, Value, Durable Goods Industries*
   U. S. Department of Commerce, Office of Business Economics, *Survey of Current Business* and advance monthly news release, "Manufacturers' Sales and Inventories." Seasonal adjustment by compiler.
4. *Construction Contracts Awarded, Residential Buildings, Floor Area*
   Dodge Statistical Research Service, monthly release, "Construction Contracts Awarded, 37 Eastern States," Sections I and II. Seasonal adjustment by NBER.
5. *Construction Contracts Awarded, Commercial and Industrial Buildings, Floor Area*
   Same as series 4. Data are sum of "Commercial Buildings," "Manufacturing Buildings," and "Theatre Buildings—Etc." Seasonal adjustment by NBER. Value data for commercial and manufacturing building are published in the *Federal Reserve Bulletin.*
6. *Average Weekly Hours, Manufacturing*
   U. S. Bureau of Labor Statistics, *Hours and Earnings Industry Report* and advance monthly news release. Seasonal adjustment by NBER.
7. *New Business Incorporations*
   Dun & Bradstreet, Inc., *Dun's Statistical Review* and advance monthly press release. Seasonal adjustment by NBER.
8. *Index of Spot Market Prices*
   U. S. Bureau of Labor Statistics, weekly release, "Daily Index Numbers and Spot Primary Market Prices"; also daily in *New York Times.* Data used are for the trading day on or nearest the 15th of each month. No seasonal adjustment necessary.
9. *Employees in Nonagricultural Establishments*
   Compiled by U. S. Bureau of Labor Statistics. Seasonally adjusted data published by Board of Governors of the Federal Reserve System in *Federal Reserve Bulletin* and in advance monthly news release, "Employment in Nonagricultural Establishments."
10. *Unemployment*
    U. S. Bureau of the Census, "Current Population Reports: Labor Force," Series P-57 ("Monthly Report on the Labor Force") and advance monthly press release. Seasonal adjustment by NBER.
11. *Bank Debits outside New York City*
    Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin* and advance monthly release, "Bank Debits to Demand Deposit Accounts." Seasonal adjustment by NBER.
12. *Freight Cars Loaded*
    Association of American Railroads, Car Service Division, weekly release, "Revenue Freight Loaded and Received from Connections." Monthly averages of published weekly figures; a week ending on the 1st, 2nd, or 3rd day of the month is included with the weeks for the preceding month. As a preliminary estimate of the current monthly average, the average of the last four weeks currently available may be used. Seasonal adjustment by NBER.
13. *Index of Industrial Production*
    Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin* and advance monthly release, "Business Indexes." Seasonal adjustment by compiler.
14. *Index of Wholesale Prices, All Commodities other than Farm Products and Foods*
    U. S. Bureau of Labor Statistics, monthly release, "Wholesale (Primary Market) Price Index." As a preliminary estimate for the current month, the weekly figure for the week closest to the middle of the month may be used. (Weekly figures are published by BLS in weekly release.) No seasonal adjustment necessary.
15. *Corporate Profits after Tax (quarterly)*
    U. S. Department of Commerce, Office of Business Economics, *Survey of Current Business* and advance news release. Preliminary estimates are published from time to time in *Economic Indicators* (Joint Committee on the Economic Report). Seasonal adjustment by compiler.
16. *Gross National Product (quarterly)*
    Same as series 15.
17. *Personal Income*
    U. S. Department of Commerce, Office of Business Economics, *Survey of Current Business* and advance monthly news release, "Personal Income." Seasonal adjustment by compiler.
18. *Sales of Retail Stores*
    Compiled by U. S. Bureau of the Census. Seasonally adjusted data published by U. S. Department of Commerce in *Survey of Current Business,* and in advance monthly news release.
19. *Consumer Instalment Credit Outstanding*
    Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin* and advance monthly release, "Consumer Credit." Seasonal adjustment by NBER.
20. *Manufacturers' Inventories, Book Value*
    Same as series 3.
21. *Bank Rates on Business Loans (quarterly)*
    Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin.* No seasonal adjustment necessary.

Note: The *Survey of Current Business* carries all the above series except 5, 8, and 12 (series 12 is given in a slightly different form), but is not as up to date as the sources listed. A number of the series are carried in the *Federal Reserve Bulletin* and in *Economic Indicators.* The *Monthly Review of Credit and Business Conditions* of the Federal Reserve Bank of New York also shows a number of the series regularly, with a different seasonal adjustment for series 11, and with no adjustment for series 6, 10, and 19.

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REPORT OF THE ASA COMMITTEE ON CENSUS ENUMERATION AREAS FOR 1953

Early in 1953 the Bureau of the Census completed the publication of the last of the P-D Series of 64 bulletins "Statistics for Census Tracts," one for each of the tracted areas. Organizations and individuals in most of these cities have worked with the published material and utilized it in various ways, such as "Social Facts by Census Tracts" published in Boston, "Tract Facts" published in Buffalo, "New Orleans Population Handbook," and many other census tract publications issued by various groups throughout the country. The Real Property Inventory in Cleveland published "Census Facts by Tracts," a 32-page monograph showing a series of spot maps based on the facts presented in "Statistics for Census Tracts for Cleveland," also a 16-page monograph entitled "Family Income by Tracts."

A number of Census Tract Street Indexes have been published during the year—Akron Austin, Boston, Cincinnati, Detroit, Lansing, Nashville, Oakland, Portland, Savannah, and others. This makes it possible to allocate addresses of all sorts by census tracts.

The field staff of the Bureau of the Census has continued to promote the extension of census tracts: (a) in new cities; and (b) in Standard Metropolitan Areas of all tracted cities. Census tracts were created in a number of additional communities. More and more areas surrounding central tracted cities are being laid out in census tracts. Forty-four entire Standard Metropolitan Areas have been completely tracted.

Key Census Tract persons have been appointed for new tracted areas as soon as the Bureau of the Census has approved the tract layouts. New Key Census Tract persons have been appointed to replace those who have left their respective communities, and changes in key persons have been made in other places, particularly in Providence, R. I.

In April copies of the papers and reports given at the meeting in Chicago on December 28, 1952, were mailed to the members of the committee, to the Key Census Tract Person in each tracted community, and to persons in other cities interested in tracting their communities.

Copies of the program for the Washington meeting held on December 30 were sent on December 3 to persons interested in census tracts in local communities. These persons were urged to attend the Washington Census Tract Conference. The luncheon and afternoon session on December 30 in Washington was attended by more than 100 persons. Doctor Robert W. Burgess, Director of the Bureau of the Census, presented a paper, "The Relation of Census Tracts to the General Census Program." He was followed by Mr. Perry H. Meyers of the Allied Stores Corporation, New York City, who described how census tract data are used by department stores; by Miss Beulah Washabaugh who read a paper prepared by Mr. George Duggar of the Bureau of Public Administration, University of California, showing the use of tract data in a study of three cities; by Doctor Ferdinand F. Mauser who presented the use of tract data by automobile manufacturers; by Doctor Meredith Givens who described how his organization had tracted labor data to compare place of employment with place of residence in New York; by Miss Florence Cuttrell who reviewed in an interesting manner the great variety of uses made of tract data in New York City; and by Mrs. Dorothy S. Montgomery who discussed the use of tracts by housing people in Philadelphia. Opportunity was provided for Key Persons to discuss their problems with Bureau of the Census officials.

A dinner meeting of the Committee on Census Enumeration Areas was held on Tuesday, December 29. Seven members of the committee attended. Plans for the further development of the use of census tracts in the various tracted communities were discussed.

HOWARD WHIPPLE GREEN, *Chairman*

C. E. Batschelet
Howard G. Brunsman
W. Thurber Fales*
Philip M. Hauser
Lyman L. Hill
Stanley W. Kadow
Earl Lomon Koos
O. E. Lemieux
Harlin G. Loomer
Dorothy W. Myers
Conrad Taeuber
Leon E. Truesdell

* Deceased.

NEWS ABOUT MEMBERS

James R. Abernathy is now Statistician at the Bureau of Vital Statistics, Jefferson County Health Department, Birmingham, Alabama.

Edward P. Coleman, formerly Visiting Professor, has been appointed Professor in the Department of Engineering, University of California at Los Angeles.

Parker D. Deans has held the position of Area Supervisor—Quality Control, with E. I. du Pont de Nemours and Company, Inc., since 1952. He is in the Explosives Department, Atomic Energy Division of the Savannah River Plant, South Carolina.

George L. Edgett of Queens University, Toronto, Canada, is at present Visiting Research Professor in Statistics at the Virginia Polytechnic Institute.

I. S. Falk, Director of Research and Statistics in the Social Security Administration, has accepted an invitation to join a mission being sent to Malaya and Singapore by the International Bank for Reconstruction and Development. He will be on leave of absence for this assignment through June 30, 1954, when his resignation from the Social Security Administration will take effect.

Kenneth Field, Director of Industrial Relations Research and Policy and Procedure Development, United States Steel Corporation, was a member of the Office of Defense Mobilization Committee on Manpower Resources for National Security, which recently recommended to the Eisenhower Administration that substantial changes be made in the policies in procuring and allocating manpower to the Armed Forces.

E. Stewart Freeman has retired after nearly forty-seven years with the Dennison Manufacturing Company, Framingham, Massachusetts.

Anne E. Geddes, Chief of the Division of Program Statistics and Analysis of the Bureau of Public Assistance, has resigned from the the Social Security Administration to join the staff of the Russell Sage Foundation to work on a project at the University of California at Berkeley.

Leon S. Geoffrey has been reassigned within the Department of Commerce to serve as staff assistant to the Director, Office of Field Services.

William C. George, Chief of the Import Statistics Section, Foreign Trade Division, Bureau of the Census, has accepted a temporary assignment in the Office of the Coordinator, International Statistics, to serve as a Point IV consultant to Jidda, Saudi Arabia.

Maurice I. Gershenson, Chief, Division of Labor Statistics and Research, California State Department of Industrial Relations, has been appointed a member of the Committee on Statistics of the International Association of Industrial Accident Boards and Commissions. He has also been re-appointed to the Morbidity Research Project Advisory Committee, California Department of Public Health; the Committee on Data Sources, American Statistical Association, and the Z16 Accident Statistics Committee of the American Standards Association, as American Statistical Association representative.

Richard W. Graves is on leave from his position as an instructor in Statistics at Tulane University to work on a DBA degree at Indiana University. His major field is management, with a minor in statistics.

Leon Greenberg has been designated Acting Chief of the Division of Productivity and Technological Developments of the Bureau of Labor Statistics.

E. J. Gumbel, Columbia University, has been appointed Visiting Professor for Statistics at the Free University Berlin (West) for the 1954 summer term.

Harry H. Harman, after six years as Chief of the Statistical Research and Analysis Section, Personnel Research Branch, AGO, Department of the Army, resigned in October 1953 to accept a position with the RAND Corporation. He is engaged in a Systems Training Program for the Air Defense Command.

Abner Hurwitz has completed his special assignment with the Foreign Operations Administration and has returned to his position as Chief of the Cost of Living Branch, Division of Prices and Cost of Living, Bureau of Labor Statistics.

Esther C. Jackson is now a statistician with the Naval Ordnance Laboratory at Corona, California.

Samuel Joffe, formerly in private actuarial practice, has been appointed Chief, Analysis and Evaluation Branch, Acturial and Financial Services Division, Bureau of Employment Security.

Hyman B. Kaitz, formerly with the National Income Division of the Department of Commerce, has returned to the Unemployment Insurance Service as Chief of the Acturial Methods and Estimates Branch, and, concurrently, as Assistant Chief of the Actuarial and Financial Services Division, Bureau of Employment Security.

Warren J. Lotz is attending the Chrysler Institute of Engineering Graduate School of the Chrysler Corporation in Detroit, Michigan.

Davis McEntire is on sabbatical leave from his position as Professor of Social Welfare in the University of California, Berkeley, and is spending the year in Italy doing research on the Italian population problem with reference particularly to emigration. His research is aided by a Fellowship from the John Simon Guggenheim Foundation.

Albert Mindlin, formerly a mathematical statistician in the Bureau of the Census, has transferred to the Bureau of Old Age and Survivors Insurance of the Social Security Administration.

Chester H. Minehan is temporarily in Washington for the U. S. Geological Survey, reviewing records prior to publication and receiving advance training in hydrological studies. He will later be transferred to Louisville, Kentucky, where he will work on compilation reports and bridge design and will be supervisor of field work in the Louisville area.

J. E. Morton is on leave of absence from Cornell University to the National Science Foundation, where his principal duties will be to plan and direct a survey of scientific research undertaken by American industry.

D'Alton Myers, formerly Chief of the Division of Productivity and Technological Developments, Bureau of Labor Statistics, has been designated part-time Consultant to the Commissioner to represent the Commissioner in arrangements for the forthcoming Productivity Conference and perform other special assignments.

Robert J. Myers has resigned his position as Director of the Division of Production and Productivity in the FOA Special Mission to France to become Chief Statistician of the International Labour Office in Geneva.

Wallace B. Oliver, formerly with the Interindustry Research Office, Department of the Air Force, has transferred to the Air Training Command Headquarters, Scott Airforce Base, Illinois.

Melvin G. Parsons, Jr., previously with the Federal Government as a Management Analyst, has joined Eli Lilly and Company, Indianapolis, Indiana, as a Statistical Analyst in Marketing Research.

Melvin E. Salveson is taking leave from the University of California to accept a position in the Major Appliance Division of General Electric Company. He will be working on problems connected with the preparation of materials for the UNIVAC computer recently installed by that Division.

George W. Snedecor served as Professor in Experimental Statistics at Alabama Polytechnic Institute, Auburn, Alabama, during the winter quarter. This was part of the cooperative program of statistics among the Southeastern states sponsored by the Institute of Statistics of the University of North Carolina and the General Education Board.

C. H. Springer has accepted a position as Chief Engineer of the Compar Instrument Company of Holland, Michigan. The company is engaged in the manufacture of devices for the optical evaluation of surface finishes.

Melville J. Ulmer, Professor of Economics at American University, has been appointed Chairman of the Department of Economics, succeeding Fritz Karl Mann.

Gregory P. Vore, formerly with the Interindustry Economic Research Program of the Bureau of the Budget, and more recently with the National Industrial Conference Board, has joined the staff of the National Science Foundation to work on the Register of Scientific and Technical Personnel.

Earl K. Yost, Jr., has transferred from the Navy Bureau of Ordnance to the Strategic Air Command Headquarters, U. S. Air Force, Offutt AFB, Omaha, Nebraska, where he is an Operations Analyst in the field of operations research.

DESIGN OF EXPERIMENTS——**continued from page 12**

Conclusion

The Design of Experiments is the kind of "equipment" which all technical departments can use. Many industrial and governmental laboratories have added this service and quality control engineers are applying the methods to search out causes for out-of-control conditions. The pioneer stage is well past. The techniques have caught on rapidly with engineers, chemists, and physicists everywhere.

Every laboratory or organization has its own particular types of problems. Statistical planning, to be realistic, must fit the practical physical limitations involved. This means that the statistician must work closely with the investigator and become familiar with all phases of the test setup. He cannot work in a vacuum. There must be complete cooperation and confidence with a free exchange of ideas. This does not mean that he will in any way usurp the position of the investigator. His is a technical service and as such he acts as a specialized assistant or advisor on the project. Not every research problem lends itself to statistical treatment, but in many cases opportunities have been missed by the uninformed. The Design of Experiments offers promise for many complex laboratory problems.

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3. "Statistical Inference applied to Naval Engineering" by J. H. Curtiss, Lt. Commander U.S.N.R. Journal of the Amer. Soc. of Naval Engineers Vol. 58, No. 3, Aug. 1946.

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WASHINGTON—**Frederick V. Waugh,** *Asst. Chief, Bureau of Agricultural Economics, U. S. Dept. of Agriculture, Washington, D. C.;* **Margaret Martin,** *Office of Statistical Standards, Bureau of The Budget, Room 440, Washington 25, D. C.*

CHAPTER NOTES

ALBANY

The meeting on January 20 was devoted to a panel on forecasting methods. The chairman was Abbott S. Weinstein of the N. Y. State Department of Commerce, and the speakers were Dr. W. Donald Walling, Director of Research, School Buildings Commission, who discussed techniques of forecasting school enrollments; Alfred L. Bunke of the N. Y. State Division of Employment, who described forecasting of unemployment insurance claim load activities; and William I. Blair, Agricultural Statistician in charge of N. Y. State Crop Reporting Service, who spoke on crop forecasting based mainly on samples of growers' judgments as reported by mail.

CENTRAL NEW JERSEY

At the meeting held on Jan. 12th William J. Baumol, President of the Chapter and a mathematical economist at Princeton, delivered his presidential address on the subject "The Identification Problem: An Exposition." The speaker at the Jan. 25th meeting was Sidney A. Fine of the United States Employment Service, who discussed "Some Measurement Problems in Estimating Worker Characteristics Requirements of Jobs." The subject of the Feb. 8th meeting was "Examination Problems in the Public Service." The speakers were Fred R. Alleman, Director of the Examination Division of the N. J. State Department of Civil Service, and William Druz, Supervising Principal Personnel Technician in the Examination Division.

Dr. Baumol, who is at the University of California for the spring term, has been succeeded as President by William Netschert, formerly Vice-President. The 2nd Vice-President, C. S. Pittindrigh, has become Vice-President. Mr. Netschert is Supervisor of the Research Section, N. J. Division of Employment Security, and Mr. Pittindrigh is Associate Professor of Biology at Princeton.

CHICAGO

A joint luncheon meeting with the Chicago Chapter of the American Marketing Association was held on Jan. 7th, at which W. E. Anklam of the General Mills Research Laboratories discussed the use of market research as a device to aid management decisions on what new product possibilities are to be studied in the laboratory. At the luncheon meeting on Jan. 21st, Dr. Isidore Altman of the Commission on Financing of Hospital Care described current problems in the economics of medical care and the use of statistical methods in their analysis. The January 26th dinner meeting was a joint meeting with the Investment Analysts Society of Chicago. Richard B. Heflebower, head of the Department of Economics at Northwestern University, spoke on "How to Study Competition Forces in an Industry."

Luncheon meetings were held in February on the 4th and the 18th. At the first, the speaker was Rev. T. V. Purcell, S.J., Associate Professor of Industrial Psychology at Loyola University, whose subject was "Quantifying Elusive Employee Attitudes." The second heard Dr. William Andrew Paton, Accountant and Economist at the University of Michigan, speak on "What Happens to Regulated Business under Changing Price Levels?". The dinner meeting was held on February 11th, and the speaker was Ralph J. Watkins, Director of Research of Dun and Bradstreet and President-Elect of the ASA. His subject was "The Long Look Ahead," a discussion of some of the basic trends which will influence American life for many years to come.

The Government Statisticians Committee of the Chicago Chapter held meetings on January 28th and February 23rd. The topic for the first was "Current Estimates of Employment, Hours and Earnings in the Chicago Metropolitan Area," and the speaker was Mrs. Elizabeth J. Slotkin, Chief of Research and Statistics of the Illinois Department of Labor. The speaker at the second meeting was Elizabeth L. Breckinridge, Economist and Gerontologist, whose subject was "The Aged and Retired as Problems for Research."

DENVER

The second seminar session of the year was held on Dec. 8th. The topic was "Some Problems of Sampling," and the leader was George E. Bardwell of the Bureau of Business and Social Research of the University of Denver. At the dinner meeting of Jan. 19th the Honorable Orie L. Phillips, Judge of the Tenth U. S. Circuit Court of Appeals, spoke on "Statistics as Admissible Evidence in the Courts."

HAWAII

A dinner meeting was held on Feb. 4th at which the new officers were installed. Members and guests then saw "Piercing the Unknown," a movie about the development and use of electronic computers, produced by IBM.

LOS ANGELES

The dinner meeting of Jan. 27th heard John C. McKee, Statistical Analyst with the Douglas Aircraft Co. and President of the Los Angeles Chapter, discuss "The Statistician's Place in the Aircraft Industry." At the Feb. 24th meeting the speaker was Ronald M. Ketcham, Washington representative of the Los Angeles Chamber of Commerce, who spoke on "Statistics in Federal Affairs."

MILWAUKEE

The speaker at the Jan. 11th meeting was Dr. Irwin A. Gaumnitz, Professor of Commerce and Assistant Dean of the School of Commerce of the University of Wisconsin, whose subject was "The Relation of Data to Formulas." Dr. Gaumnitz introduced several examples in which blind applications of formulae may be misleading, and pointed out that the use of logical and scientific reasoning is as important as the mathematics involved.

NEW YORK

The meeting held on Feb. 17th dealt with "Statistics and Tobacco." The chairman of the meeting, A. J. Jaffe, Bureau of Applied Social Research, Columbia University, introduced the topic by very briefly reviewing the statistical history of tobacco use and type of consumption together with popular attitudes toward tobacco. The rise in consumption of cigarettes since the period of World War I was noted.

The first speaker, E. Cuyler Hammond of the American Cancer Society, spoke on "Lung Cancer and Common Inhalants." He briefly reviewed the statistical evidence to show that associated with the increase in lung cancer were increases in various other substances which could be related to lung cancer; these include soot and fumes from the burning of fuel oil, fumes from motor vehicles, and the fine dust in the air from road surfaces, as well as cigarette smoke. The statistics do not clearly prove

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any relationship between lung cancer and any of these inhalants.

Robert L. Vought and E. Gurney Clark, School of Public Health and the Bureau of Applied Social Research, Columbia University, presented a review of the literature on "Tobacco, Blood Pressure and Hypertension." Their review of the experimental materials revealed numbers of statistical inadequacies in such work including the use of too small and unrepresentative samples, the lack of uniformity on a statistical definition of hypertension and the lack of other adequate statistical controls. As a result the various medico-statistical studies prove almost nothing except that smoking as well as other substances and human activities can increase blood pressure.

The papers presented at the Oct. 21st meeting on the Puerto Rican Population of New York City have been published by the Bureau of Applied Social Research, Columbia University. Copies are available free by requesting them from the Bureau.

NEW ORLEANS

A dinner meeting was held on Jan. 12th devoted to the "Business Outlook for 1954." The panel consisted of four members of the faculty of Tulane University—Dr. Robert W. French, Vice President and Dean of the School of Business Administration; Dr. Gerald E. Warren, Professor of Economics; Dr. Clarence H. Danhof, Professor of Economics; and Dr. Howard G. Schaller, Assistant Professor of Economics.

The following officers have been elected for 1954:

President, MRS. OPAL S. LOOBY.

1st Vice-President and Chairman of the Program Committee, ROLAND PERTUIT.

2nd Vice-President and Chairman of the Membership Committee, ALBERT L. JOHNSON.

Secretary-Treasurer, ELSIE M. WATTERS.

OKLAHOMA CITY

The annual dinner and business meeting was held on Jan. 6th. The following officers were elected for 1954:

President, PROFESSOR MITCHELL LOCKS.

2nd Vice-President (Membership Chairman), WENDELL PHILLIPS.

Secretary-Treasurer, ROBERT W. STAPLES.

At the Feb. 3rd meeting R. O. Mason discussed "Oklahoma's Per Capita Income," and Robert W. Staples of the Oklahoma Gas and Electric Co. spoke on "A Statistical Survey in the Public Utility Industry." The survey is being made of a sample of households to determine the ownership of electrical appliances and their load characteristics.

PHILADELPHIA

The speaker at the dinner meeting held on Jan. 8th was Dr. Elmer C. Bratt, Professor of Economics at Lehigh University. Dr. Bratt spoke on "Short-Term Methods of Forecasting as Related to the Forecast of 1954." The Feb. 19th dinner meeting heard Martin R. Gainsbrugh, Chief Economist of the National Industrial Conference Board, discuss "The Business Outlook."

PUERTO RICO

The annual business meeting of the Chapter was held on Jan. 29th. Dr. Abe Jaffe, consultant to the Bureau of Labor Statistics, and José L. Janer, head of the Bureau of Demographic Registry, spoke on recent population changes in Puerto Rico. They explained the factors behind the birth and fertility rates, as well as the death and migration rates, and examined the likelihood of these trends continuing to operate in the years ahead. Their conclusion was that 1) although the death rate can still go down somewhat, the reduction will not be significant, and 2) the trend of fertility rates indicates that the slight reduction evidenced by the birth rate cannot yet be taken as indicative of a definite trend in that direction.

The following officers were elected for 1954:

President, CÁNDIDO OLIVERAS, Head, Bureau of Economics and Statistics, Puerto Rico Planning Board.

Vice-President, RAMÓN COLÓN TORRES, Secretary of Agriculture.

Secretary, DR. LUZ M. TORRUELLAS, Social Science Research Center and College of Social Sciences, University of Puerto Rico.

Treasurer, CARMEN ALCAREZ, Economist, Bureau of Economics and Statistics, Puerto Rico Planning Board.

SAN FRANCISCO

A dinner meeting was held on Feb. 24th at which the speaker was Meyer A. Girshick, Professor of Statistics at Stanford University. Professor Girshick's subject was "Modern Statistical Decision Theory."

Chapter officers elected for the current year are the following:

President, WILLIAM O. JONES, Food Research Institute, Stanford University.

Vice-President, GEORGE M. KUZNETS, University of California.

Secretary-Treasurer, WINTON PETTIBONE, Economics Department, Standard Oil Company of California.

ST. LOUIS

At the luncheon meeting held on Jan. 27th Don A. Livingston, Statistician, Monsanto Chemical Co., spoke on "Aids in Operational and Business Decisions." Mr. Livingston presented techniques which have been developed at Monsanto to keep top management supplied with statistical and financial information on the company's operations. On Feb. 17th Manley Rice, Store Operations Manager of the Brown Shoe Co., addressed a luncheon meeting on "Surveying Retail Demand." Mr. Rice discussed methods of measuring markets which have been successful at Brown Shoe Co., and illustrated his talk with two case histories.

WASHINGTON

At the Jan. 25th meeting, staff of the Division of Research and Statistics of the Federal Reserve Board gave a visual presentation, "Industrial Production Index Revised." This consists in using a Vu-Graph machine to project colored slides onto a translucent screen from the rear. It was the same presentation given at the ASA annual meetings.

The annual dinner meeting of the Washington Chapter was held on March 4th. Dr. Robert Calkins, President of Brookings Institution, spoke on "Research for Policy."